# MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 39 MAY, 1933 Number 9

## PRINCIPAL ARTICLES IN THIS NUMBER

FOR COMPLETE CLASSIFIED CONTENTS, SEE PAGE 624



## DEPARTMENTS



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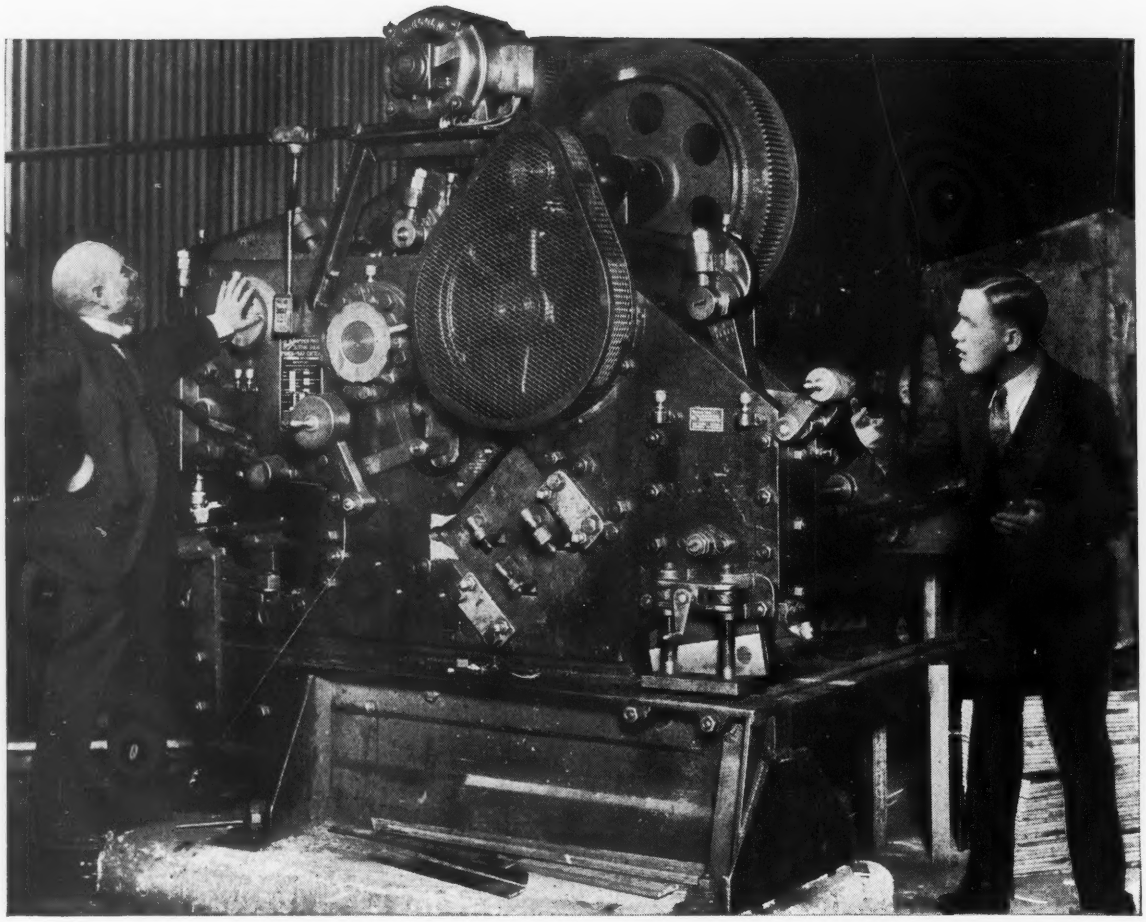

"A new deal, a better hand and a low ante. That's what we're getting by installing a 'Linc-Weld' motor on this combination slitting shear punch and bar cutter.

"If it were not a half-high torque type 'Linc-Weld' DL we would have had to buy a larger size motor. This new DeaL saved us money on the original cost of that motor."

"Don't forget that along with that new deal we get a nice stack of blue chips too. Chips in the form of lower current costs and a minimum peak load.

"Remember, the rating on a motor doesn't tell the whole story. This 'Linc-Weld' DL gives us the lowest cost per pound of material put through this press. After all, that's what counts. And if we are saving money, we are making money—getting more out of the pot. Incidentally, the repair man gets less.

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# LINCOLN

**THE LINCOLN ELECTRIC COMPANY, CLEVELAND, OHIO**

**Manufacturers of *"Linc-Weld"* Motors and *"Stable-Arc"* Welders** M II

# MACHINERY

Volume 39 NEW YORK, MAY, 1933 Number 9


# *How Electric Refrigerators are Made Noiseless*

By CHARLES O. HERB

*Pistons of Electric Refrigerators are Expected to Make Billions of Strokes Noiselessly*

*Quietness and Accuracy Go Together—Year after Year of Uninterrupted Service is Assured*

IN an electric refrigerator, the parts of greatest interest to the mechanical man are the piston and cylinder of the refrigerating unit, because it is largely upon these parts that quiet operation depends. The refrigerating units built by the Westinghouse Electric & Mfg. Co. at its Springfield, Mass., plant are expected to operate quietly year after year wlthout any attention whatsoever. These units are hermetically sealed, after specified amounts of oil and refrigerant have been applied. No provision is made for adding to them, because since dirt, air, and moisture cannot enter the unit, nor oil or gas leak out, the original quantity and quality of refrigerant and oil are retained and replenishment is unnecessary.

During one year of normal refrigeration, the piston in one of these electric refrigerators makes approximately one quarter of a billion strokes. It has been estimated that the same number of strokes would drive the family car 125,000 miles. Can anyone conceive of driving an automobile that distance without any attention being given to the engine? Yet a year is but a small part of the total time that an electric refrigerator is expected to operate with entire satisfaction.

The piston of Westinghouse refrigerators reciprocates at the rate of 1750 strokes per minute. Quiet operation at such a speed requires parts machined to within close limits of accuracy and having a high quality finish. The pistons are turned from

*Fig. 1. The Piston and Cylinder of the Refrigerating Unit are Fitted so Accurately that an Oil Film Alone Seals Them*

high-carbon tool steel in bar form by automatic screw machines. After being heat-treated, the pistons are ground to a slight taper at the closed end in a centerless grinder, and then the outside cylindrical surface is ground four times in other machines of the centerless type. At the end of the fourth grind, the pistons must be true to size within a tolerance of 0.0016 inch and cannot be more than 0.0001 inch out of round. The limits on the diameter are 0.9995 and 1.0011 inches. The pistons are 1 1/2 inches long, and the wall 1/16 inch thick.

After the final grind, the pistons are inspected for hardness and finish, and then the diameter is checked by means of the optical instrument seen in the heading illustration. In this inspection, the pistons are graded into eight distinct groups, or zones, according to their diameter. The difference between any two pistons of the same zone cannot be more than 0.0002 inch, and the difference between any two pistons of the extreme zones cannot be more than 0.0016 inch, the total tolerance allowed on the pistons in the final grinding operation. As the pistons are graded, they are etched for identification.

Later, in assembling the refrigerating units (see Fig. 1), the pistons of each group are selected to suit cylinders correspondingly grouped. The difference in the diameter of a mating piston and cylinder must be between 0.0006 and 0.0008 inch, so as to

*Fig. 2. Honing after Internal Grinding Produces the High Quality Finish Specified for Small-diameter Cylinders*

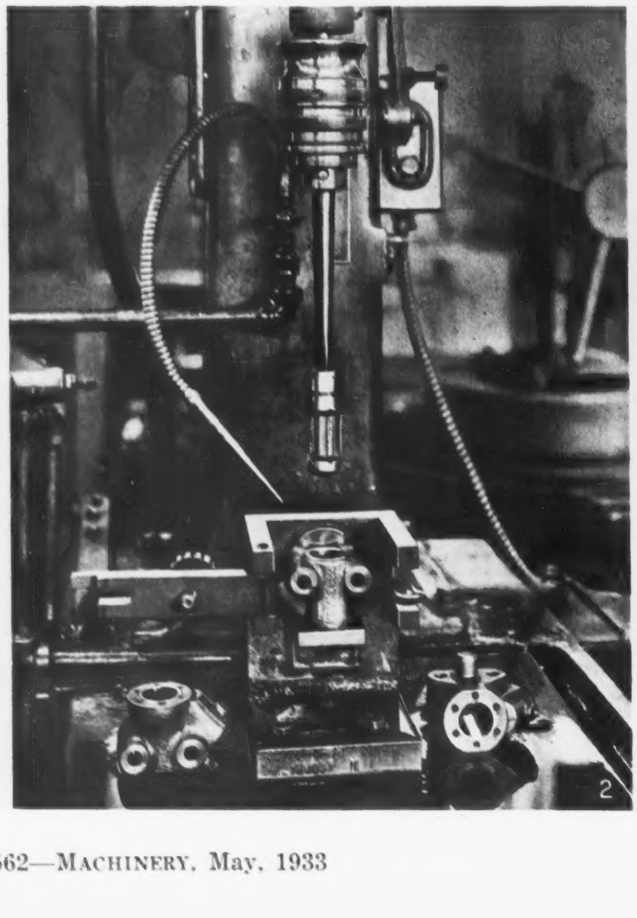
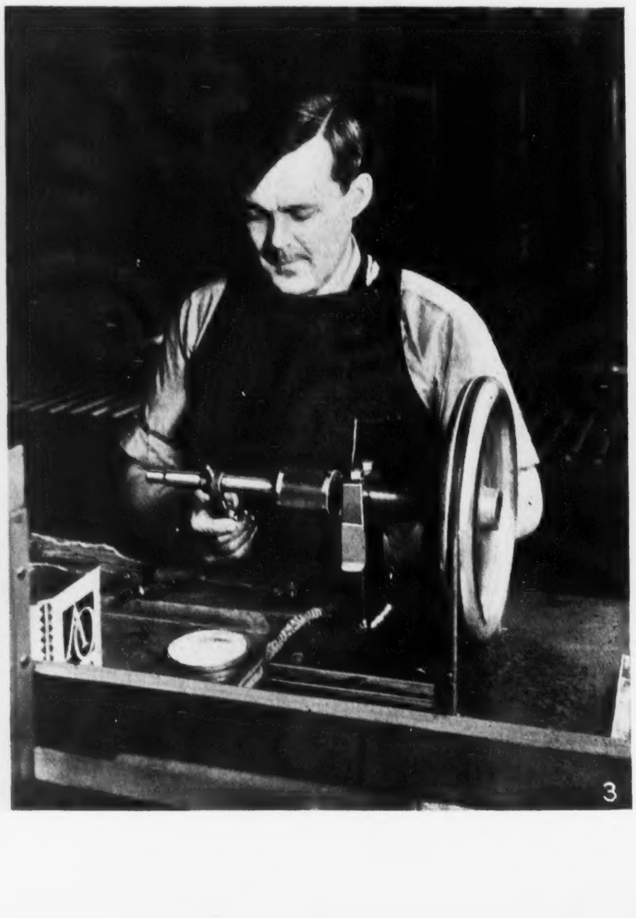


*Fig. 3. The Connecting-rod Bores are Lapped on a Revolving Mandrel to which a Fine Abrasive Compound has been Applied*



allow the necessary clearance for an oil film. Rings are not used on these pistons, the oil film alone being relied upon to act as a seal between the piston and cylinder walls.

The optical instrument in the heading illustration is set to master gage-blocks, accurate to within three millionths of an inch. These blocks are provided with fiber grips, so that heat cannot be imparted to them from the fingers of the user. Readings are easily made with the optical instrument, as a difference of 0.0002 inch in the work appears as large as 1/2 inch on the optical screen.

### Honing Gives the High Finish Required for the Cylinders

The cylinders are gray iron castings of an analysis selected because it is only slightly affected by quick changes in temperature. Before leaving the foundry, the castings are heat-treated to relieve all strains. In the machine shop, the cylinder hole is bored, reamed, ground, and honed to between limits of 0.9995 and 1.0011 inches, the tolerance again being 0.0016 inch. From 0.001 to 0.0015 inch of stock is removed in the honing operation, which is shown in Fig. 2.

As in the case of the pistons, one of the important steps in the cylinder inspection routine consists of grading the cylinders into eight zones or groups having a maximum difference of 0.0002 inch between any two cylinders of a group. This grading is quickly accomplished by means of the electric gage illustrated in Fig. 4, which also amplifies differences of 0.0002 inch to approximately 1/2 inch. The instrument is calibrated at given intervals during the day by means of a master gage accurate to within five millionths of an inch.

Each cylinder bore is measured throughout its

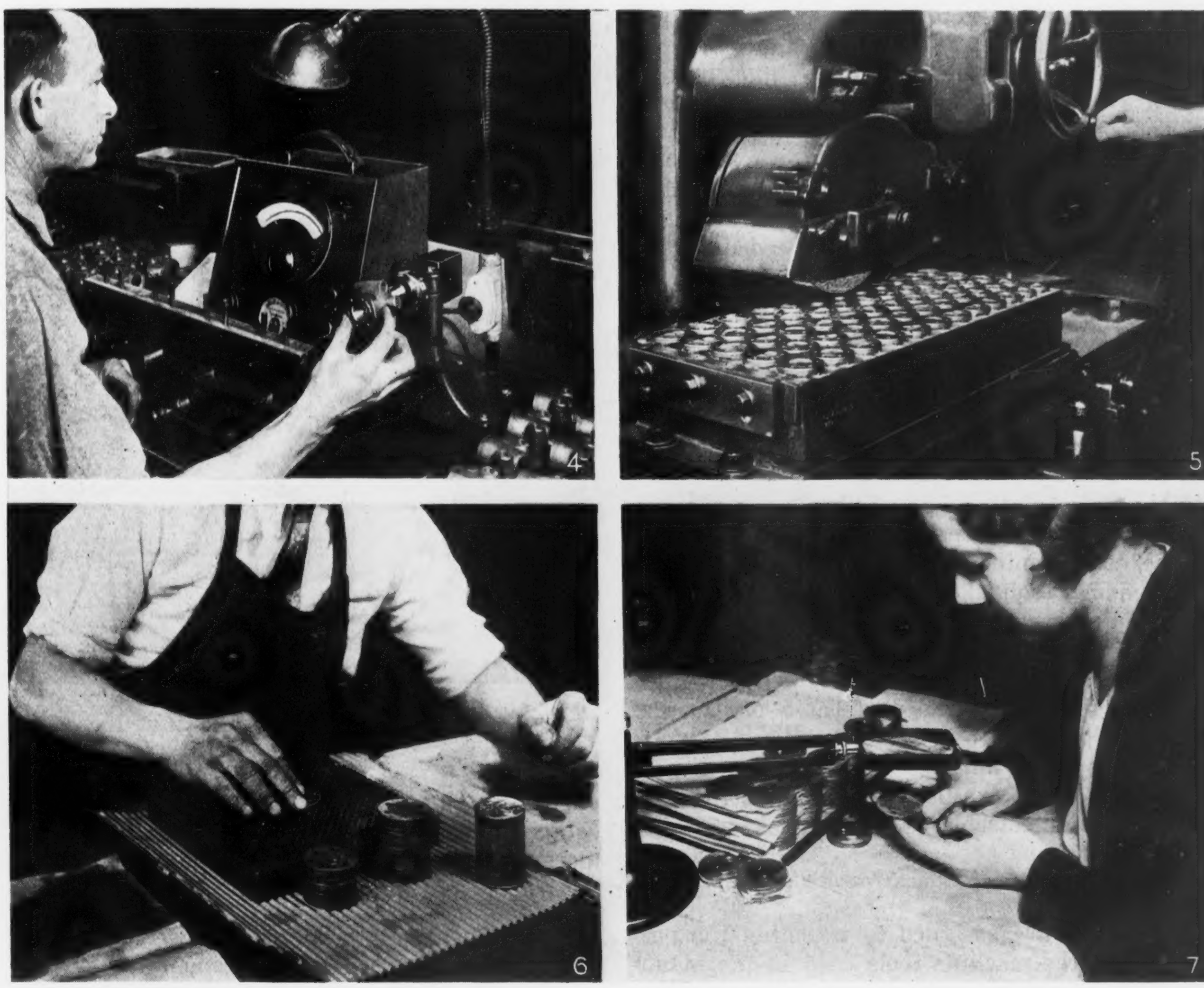



*Fig. 4. An Electric Gage is Used to Check the Cylinders Closely and to Group Them into Zones Varying by 0.0002 Inch. Fig. 5. The Cylinder Heads are Ground on Both Sides and then Lapped on the Side that is to be in Contact with the Valve Plate. Fig. 6. The Valve Plates are Lapped on Both Sides to Insure a Tight Fit against the Cylinder and the Cylinder Head without the Use of Gaskets. Fig. 7. A Strong Magnifying Glass Shows up Surface Defects on the Valve Plates*

entire length because its walls must be parallel and straight within 0.0001 inch. The cylinders are quickly marked for identification by placing them beneath the proper punch or stamp on the fixture at the front of the inspection instrument and then tapping the stamp with a hammer. The stamps are held in place by springs.

Each cylinder is ground and lapped on one end to such a fine fit with the valve plate that no gasket need be used between the two parts.

### Connecting-Rod Bores are Lapped

Both holes of the connecting-rod are lapped, as illustrated in Fig. 3, after they have been ground and then honed with an emery stone. In the lapping, the part is moved back and forth over a brass mandrel to which an abrasive compound has been applied. This compound is a very fine grade of emery dust prepared by the American Optical Co. for use in the manufacture of optical lenses. It is mixed with kerosene.

The nominal diameters of the connecting-rod holes are 3/8 and 7/8 inch. They are held to the specified sizes within 0.0002 inch.

The countershaft and wrist-pin are made of Nitralloy. The clearance between the countershaft and the main bearing is held to between 0.0005 and 0.0008 inch, while the clearance between the wrist-pin and the connecting-rod bearing must be between 0.0002 and 0.0003 inch.

### Precise Cylinder Heads and Valve Plates Eliminate Need of Gaskets

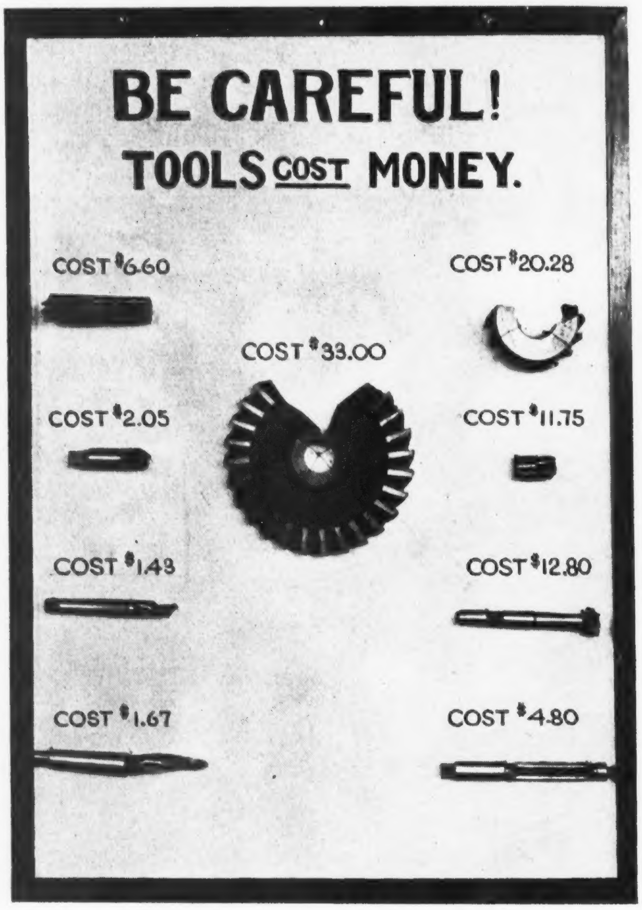
Fig. 1 shows how the valve plate and the cylinder head are fitted on the closed end of the cylinder. Both the valve plates and cylinder heads are surface-ground and are then hand-lapped until they are true, as determined by applying bluing and rubbing them on a toolmaker's surface plate. This high degree of accuracy is required because the fit alone is relied upon for tight joints, gaskets being eliminated. Such an accurate fit is obtained that there is no leakage between the parts at a pressure of 200 pounds per square inch. The valve plates are carefully inspected and examined through a magnifying glass, as shown in Fig. 7, for scratches and other surface defects.

### "Floating Inspectors" Check Machines and Tools

Several men are assigned to watching the performance of the machine tools used in the manufacture of these refrigerating units to see that the machines are kept in first-class condition, that cutters are always sharp, and that the operators produce the work according to the standards that have been established. For instance, one man sees that all hones are satisfactory; another looks after milling cutters, and so on. The approval of these "floating inspectors" must be obtained before production can be started after a machine has been retooled.

## An Exhibition Board of Broken Tools

In the shop of the Logansport Machine Co., Logansport, Ind., a board is posted to which are attached the remains of broken tools that have met with disaster in the course of the operation of the shop. Above the fragments of each broken tool is inscribed the cost of the tool. This is a simple and effective way of bringing home to everybody concerned with the use of tools in the plant the value of the tools that are handled and the importance of exercising care so that the damage to tools and equipment may be reduced to a minimum. A little more care will save hundreds of dollars in a year.




Board Showing Cost of Broken Tools

* * *

An interesting use for cellophane in industry was recently noted. In a plant manufacturing motors, it was found that the lacquer finish on the motors was easily marred by pressure, particularly when the motors were piled up in stacks, as is frequently the case. Various materials were placed between these motors to prevent them from being marred. It was found that cellophane completely eliminated the difficulty, as it pulls free from the paint or lacquer, leaving no imprint and no fuzz.

# How to Obtain Best Results in Roll-Grinding

**Last of a Series of Five Articles Giving Complete Directions for Roll-Grinding Operations and Wheel Selection**

By H. J. WILLS, Engineer
The Carborundum Co., Niagara Falls, N. Y.

THE fourth article of this series, published on page 505 of April MACHINERY, dealt with the grinding of rubber rolls, steckel-mill rolls, foil rolls, and copper rolls for intaglio printing. The present installment, which is the last of the series, will treat of roll scouring and polishing, lapping small rolls, trimming risers from roll necks, and grinding troubles.

### Roll Scouring and Polishing

Roll scouring as an accessory to roll grinding is an operation that has been greatly developed within the last few years. Heretofore, the scouring of tin-plate rolls and many other sheet rolls has involved considerable effort on the part of the operators and frequent breakage of the abrasive roll-scouring blocks used for this purpose. It has also been necessary to carry in stock a multiplicity of shapes, grits, and grades. The Carborundum Co. has successfully standardized on one shape and grade for average conditions, while grit choice is confined to three general applications, with some leeway for personal preferences.

| Type of Roll | Grit | Shape | Size |
|---|---|---|---|
| Tin Plate .. | 80–100 | 269/28 | 5 1/2 by 2 3/4 by 2 1/2 |
| Hot Sheet .. | 60–80–100 | 269/28 | 5 1/2 by 2 3/4 by 2 1/2 |
| Cold Sheet.. | 120–150–180 | 269/28 | 5 1/2 by 2 3/4 by 2 1/2 |

In practical operation, these roll-scouring blocks or rubs require much less pressure than the blocks formerly used. Whereas with the older types of roll-scouring blocks, it was usually necessary to mount them in a long-handled holder and the operators had to exert great pressure to cut the roll properly, it is now sufficient merely to guide the blocks with just enough pressure to keep them in contact with the roll.

The advantages of these new roll-scouring blocks are as follows: A better surface and finish is produced on the rolls; breakage of blocks is practically eliminated; the operators are less fatigued; the blocks can be worn down to the holder; the blocks will not pick up metal or load.

Because of their grading, it is suggested that some cushioning be used in the mounting jaws and under the supporting point or fulcrum. The point of contact should be about 1/4 inch off center and at a slight angle to the roll axis. Unlike the former shapes, these blocks can be swayed or oscillated against the roll.

Under certain conditions, it may be desirable to polish, scour, or dress rolls in service more frequently than is practicable with the ordinary block and scouring pole. To accomplish this, an automatic or continuous polisher is used, consisting of a driven screw which moves the abrasive blocks across the roll face with continuous and regulated pressure. Such equipment is manufactured by the Aetna-Standard Engineering Co., Youngstown, Ohio, and the Wean Engineering Co., Warren, Ohio.

### Lapping Small Rolls

In some instances it may be desirable to finish such rolls as foil rolls, jewelers' rolls, steckel-mill rolls, etc., by lapping, particularly when machine conditions are such that it is not possible to obtain the exceptional grinding quality required. There are two methods of lapping rolls which will produce a fine surface, free from scratches, with a clear transparent finish.

### Use of Split Cast-Iron Laps

Small rolls are best lapped in the conventional manner with a lap of cast iron. The laps can be easily made by turning a ring to an inside diameter 0.002 inch larger than the outside diameter of the roll, and approximately 2 inches in width. After finishing the hole, the ring is split in one place and some means provided for adjustment. The roll is moistened with Grade H-41 medium Carborundum Brand finishing compound, and the lap adjusted so that it just begins to drag. With the roll turning at a maximum speed, the lap is traversed slowly from end to end. As the roll surface is approaching perfection, the compound should be gradually thinned out with oil. It is important that the edges of the lap be well rounded to avoid scraping off the abrasive and to prevent traverse marks.

### Use of Contracting Lead Laps

A very effective lap for small rolls, such as jewelers' rolls, can be made by casting lead around the roll to the full length. The mold should be tapered. After cooling, the lap is split lengthwise and a clamp is provided with the same taper to permit adjustment. The roll is revolved in this lap with H-41 fine compound. A lengthwise spiral stroke is best, provided the roll can be shifted on its axis at each stroke. This movement can be acquired by moving the lap along the mounted roll by hand.

### Trimming Risers from Roll Necks

In the manufacture of rolls, it is necessary to remove the risers from the roll necks preliminary to

grinding. This operation is often difficult and expensive, and in the case of tough steel rolls may require several days by the usual turning method.

The use of abrasive cut-off wheels offers a much more economical method for the removal of neck risers. By the abrasive cut-off method, the risers can be quickly removed with a minimum of time and expense, reducing to a matter of a few hours an operation formerly requiring several days. In using this process, temporary centers are provided and the roll is mounted in a roll-grinding machine. A large-diameter cut-off wheel is fed directly into the roll at the desired point of removal. After a penetration of one-fourth of the neck diameter, the wheel is changed to another of the same specifications, but of slightly narrower face, to prevent binding. One grade harder wheel may be used to offset the thinner wheel section and the reduced arc of contact. The harder wheel is fed in to a point where it is possible to break off the riser with the blow of a sledge.

While aluminum-oxide wheels are effective for this cut-off operation, silicon-carbide cut-off wheels are recommended, as they are more economical and have better heat dissipation. It is obvious that the point of contact must be well flushed with coolant.

ROLL-GRINDING DATA

ROLL NO. ________

USED FOR ________ DEPT. ________

DIAMETER ________ LENGTH ________ CAMBER ________ MATERIAL ________

TOLERANCE DIA. ________ CONCENTRICITY ________ TAPER ________ FINISH ________

GRINDER ________ WHEEL SIZE ________ COOLANT ________

| OPERATION | WHEEL | STEP | WHEEL-SFPM | WORK-SFPM | TRAVERSE | FEED | PASSES |
|---|---|---|---|---|---|---|---|
| ROUGHING | | 1<br>2 | | | | | |
| SMOOTHING | | 1<br>2 | | | | | |
| SEMI-FIN. | | 1<br>2 | | | | | |
| FINISHING | | 1<br>2 | | | | | |
| ULTRA-FIN. | | 1<br>2 | | | | | |

| DRESSING | TOOL | FREQUENCY | WHEEL-SFPM | 1-FEED | PASSES | 2-FEED | PASSES |
|---|---|---|---|---|---|---|---|
| ROUGHING | | | | | | | |
| SMOOTHING | | | | | | | |
| SEMI-FIN. | | | | | | | |
| FINISHING | | | | | | | |
| ULTRA-FIN. | | | | | | | |

| WHEEL RECORD | ROLLS PER WHEEL | WHEEL CONSUMPTION cu. in. per wheel |
|---|---|---|
| ROUGHING | | |
| SMOOTHING | | |
| SEMI-FIN. | | |
| FINISHING | | |
| ULTRA-FIN. | | |

| ROLL-NECKS | WHEEL | FREQUENCY | WHEEL-SFPM | WORK-SFPM | TRAVERSE | RADIUS |
|---|---|---|---|---|---|---|
| ROUGHING | | | | | | |
| FINISHING | | | | | | |

REMARKS:

THE CARBORUNDUM COMPANY DATE ________

Form Recommended for Recording Roll-grinding Data

### Common Causes of Grinding Troubles

A number of causes of grinding troubles are listed in the following, in order of frequency:

*Chatter, Bouncing, or Hammering*

1. Wheel-spindle: Poor fit; end play; spring; internal stresses (from overloading); insufficient heating of bearings.

2. Spindle drive: Whipping belt; uneven thickness of belt or belt splices; vibration of motor, if integrally mounted; uneven speed.

3. Vibration: Machine vibration; building or foundation vibration; uneven traverse drive through rack and pinion.

4. Roll drive: Uneven gear action; uneven pressure of driving pins; faceplate out of true; driving pins not parallel with work axis; worn thrust bearings.

5. Wheel: Grading too hard; face too wide for grading of wheel; out of balance; not trued; wheel sides not true with face; glazing; wheel not tight on mounting.

6. Work mounting: Poorly designed rests; poorly fitted centers; loose centers or neck rests; centers too loose or too tight; faulty lubrication.

7. Operation: Too high spindle speed; work speed too slow or too fast; lack of lubrication of neck rests or centers; dull wheel due to poor dressing.

*Scratches and Fish-tails*

1. Coolant: Lack of filtration of machine coolant or city water; improper cleaning of guards after dressing or changing to finer wheels; gummy coolants; coolants that disintegrate wheel bond.

2. Dressing: Wheel grains only partially removed because of dull diamond; ragged wheel edges; dressing sludge left in wheel guard; wheel face and sides not properly cleaned after dressing.

3. Hammering: Wheel grains loosened by hammering of wheel on work.

4. Loose dirt: Dirt in air; dirt resting or dropping on roll.

*Diamond Marks*

1. Diamond: Too sharp, cracked, or broken; wrong angle (horizontal or vertical); lack of rigidity; dull diamond which presses in grains or bond of the wheel.

2. Traverse: Too fast for dressing; uneven hand feed; dressing at same traverse rate and direction as on work.

3. Dressing Feed: Too deep.

*Traverse Marks*

1. Wheel: Corners not rounded off; dragging edge from faulty dressing; spring in spindle; feed too deep on finishing cuts.

2. Traverse: Too fast.

3. Work Speed: Too high (should be slightly changed with each pass to break up pattern; this may be accomplished with traverse instead).

*Wheel Marks*

1. Wheels: Too big a gap between grits used; final wheel too coarse or too soft.

2. Dressing: Too coarse.

3. Operation: Lack of "finishing out" on all wheels.

*Loading or Glazing of Wheel*

1. Wheel: Too hard, either from grading or manipulation.

2. Dressing: Stone too dull; dressing too fine; dressing intervals too far apart.

3. Coolant: Too gummy or dirty.

*Work out of Round*

1. Roll supports: Rests or centers not rigid or in good condition.

2. Neck rests: Not round; infrequent grinding.

3. Temperature: Elongation of roll from temperature change, and resistance of centers to this elongation; distortion of roll.

4. Drive: Roll wabble due to poor drive.

*Work out of Parallel*

1. Grinder: Worn ways; improper setting of tailstock; centers not concentric with bodies.

2. Dressing: Dressing off center line; location of dresser causing dressing action different from that found in grinding.

3. Temperature: Roll not at room temperature.

*Burning*

1. Wheel: Too hard in effect.

2. Operation: Wheel fed to work too rapidly.

*Grading*

When the wheel effect is too hard, it may be caused by the following: (a) Wheel speed too high; (b) work speed too low; (c) traverse too low; (d) wheel feed too light; (e) wheel face too wide; (f) wheel diameter too great; (g) coolant too thick; (h) dressing too dull; (i) wheel or belt slippage.

### Roll-Grinding Data

A survey of roll-grinding shops throughout the United States and Canada reveals that less than 2 per cent of such shops keep records of wheels used and operating procedure. Lack of such records must, in time, result in repetition of trials of new wheels, lack of continuity in constructive theory for the general improvement of roll-grinding, considerable experimentation to educate new operators, and failure to duplicate surface quality from roll to roll. With this in mind, the accompanying form is offered for recording roll-grinding data.

This is the last article in a series of five on how to obtain best results in roll-grinding.

## Canadian Nickel Celebrates Fiftieth Anniversary

A celebration of the fiftieth anniversary of the discovery of the nickel deposits at Sudbury, Canada, from which a world industry has been developed was inaugurated by an address by Robert C. Stanley, president of the International Nickel Co. of Canada, Ltd., at the annual banquet of the Canadian Institute of Mining and Metallurgy, held at Toronto, April 6. On the same occasion, the International Nickel Co.'s platinum medal was awarded to James J. Denny of the McIntyre Porcupine Mines, Ltd., for his "contribution to the art of concentrating gold and silver ores."

Although it is nearly two hundred years since nickel was first discovered by chemists, its broad commercial usage is recent, dating back not more than about twenty years. The United States consumes over 50 per cent of all the nickel mined in Canada.

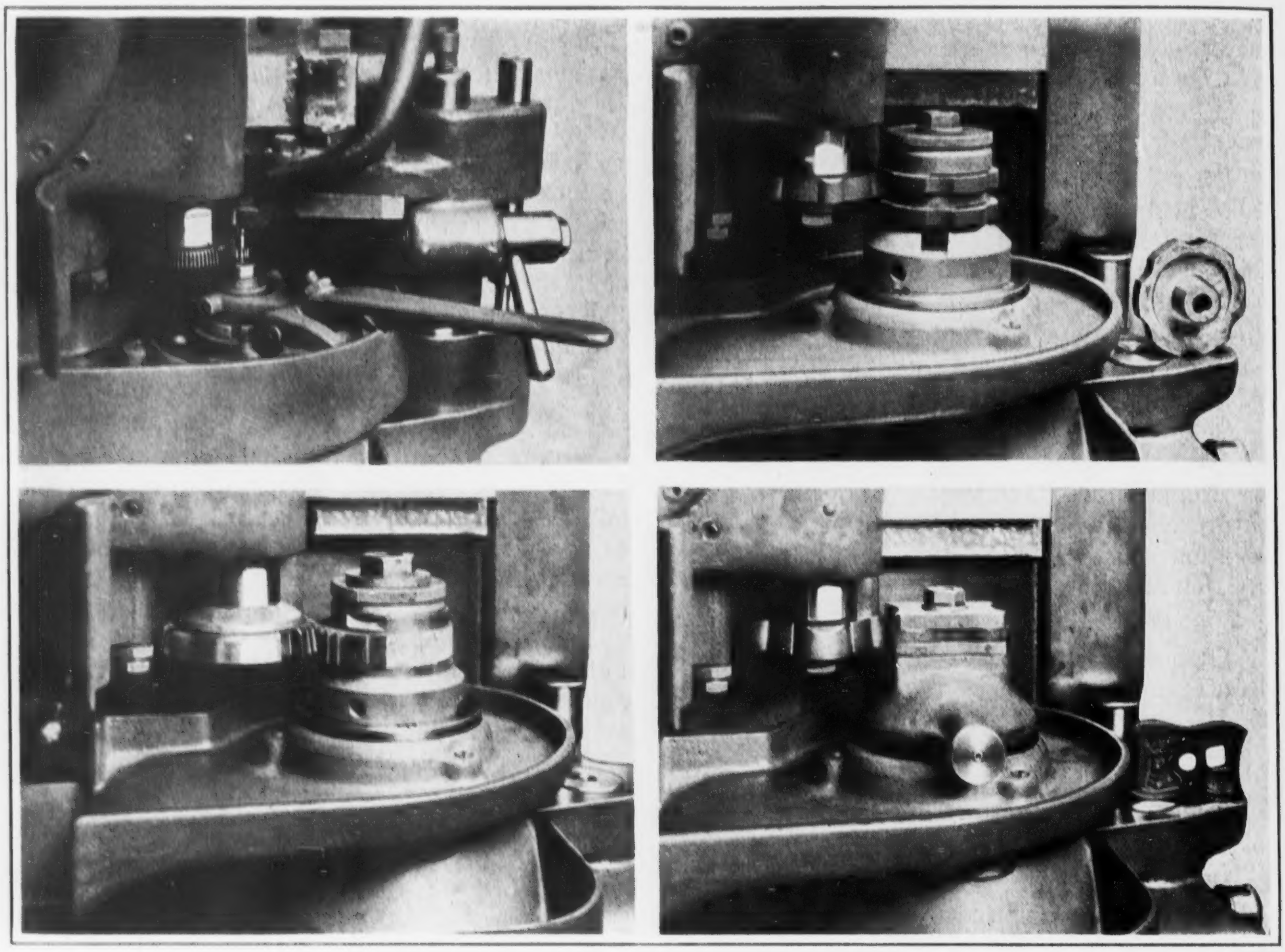
* * *

We are now on the threshold of a new stage of progress, and America must lead the way. It can go far on that way only by realizing that it is a part of the world; that the world also must move with it to new recoveries and new stabilities. Our primary remedy for present difficulties is not in the change of economic systems; it consists in an enlightened public opinion which will demand of our rulers that they seek peace, economic as well as political, and pursue it.—*Thomas W. Lamont of J. P. Morgan & Co.*

### *Tubing Covered with Stainless Steel*

***In a well-known automobile, the stainless-steel headlight tie-rod consists of a tube of ordinary steel with a wall thickness of 1/8 inch, covered with a strip of stainless steel 0.015 inch thick. The stainless-steel strip is rolled so firmly on the regular steel that the two metals become virtually one solid unit. With this design, the advantages of stainless steel are obtained at a fraction of the cost of tubing made completely from this material. How this tubing is produced will be described in an article in June MACHINERY.***

# Some Unusual Operations Performed on a Gear Shaper



The versatility of the gear shaper process as applied to generating unusual contours and highly accurate profiles is well illustrated by the examples here shown. (Upper Left-hand View). Cutting a 10-tooth, 24/32-pitch bronze pinion for a balance scale. Accuracy in cutting the teeth is the unusual feature of this job, the maximum combined error in spacing not exceeding 0.0003 inch. (Upper Right-hand View). Cutting two cast-iron chain-cylinder check wheels for an automatic loom in one operation. The spacing washers accommodate projecting hubs. The outside, or face, with the semicircular grooves is machined complete at one setting and with one cut. (Lower Left-hand View). Set-up for cutting a cast-iron interrupted gear for an automatic cotton loom. One cutter serves to cut the segment teeth and the thick projections. (Lower Right-hand View). Cutting check plates for an automatic cotton loom. These pieces are made of cast iron and are finished on both sides by surface grinding, after which they are machined from the rough, the special gear shaper cutter generating the semicircular grooves in the ends of the check plates and rounding the corners to the required radius at one setting.

▼ ▼ ▼

## LOAD CAPACITIES OF RADIAL BALL BEARINGS—SINGLE-ROW HEAVY TYPE—3

| Bore Diameter, Millimeters* | Outside Diameter, Millimeters* | Width, Millimeters* | Range of Ball Diameters, Inches | Number of Balls | Speed of Inner Ring, in Revolutions Per Minute, and Approximate Range of Load Ratings, in Pounds, for Different Makes† | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | 100 | 500 | 1000 | 3000 |
| 17 | 62 | 17 | 3/8–1/2 | 8 | 1550–3200 | 900–2000 | 750–1400 | 350–500 |
| 20 | 72 | 19 | 9/16 | 8 | 2000–3700 | 1400–2300 | 1100–1600 | 450–750 |
| 25 | 80 | 21 | 9/16–5/8 | 7–8 | 2150–4200 | 1500–2600 | 1200–1800 | 470–880 |
| 30 | 90 | 23 | 5/8–11/16 | 8–9 | 3350–5600 | 1950–3500 | 1550–2400 | 750–1050 |
| 35 | 100 | 25 | 11/16–13/16 | 9–10 | 3900–6400 | 2300–3900 | 1800–2600 | 1050–1250 |
| 40 | 110 | 27 | 13/16 | 10 | 4500–7200 | 2600–4400 | 2100–3000 | 1150–1450 |
| 45 | 120 | 29 | 13/16–7/8 | 10 | 5250–8100 | 3100–4800 | 2450–3250 | 1300–1700 |
| 50 | 130 | 31 | 13/16–1 | 8–10 | 6000–9000 | 3500–5500 | 2800–3700 | 1400–1900 |
| 55 | 140 | 33 | 7/8–1 | 10 | 6850–9850 | 4000–6000 | 3200–4300 | 1750–2200 |
| 60 | 150 | 35 | 15/16–1 3/16 | 8–10 | 7700–11300 | 4500–6350 | 3600–4800 | 1950–2500 |
| 65 | 160 | 37 | 1–1 1/4 | 8–10 | 8650–12700 | 5050–7150 | 4000–5300 | ......... |
| 70 | 180 | 42 | 1 1/8–1 5/16 | 10 | 10600–15700 | 6200–9500 | 4950–7400 | ......... |
| 75 | 190 | 45 | 1 3/16–1 1/2 | 8–10 | 11700–17300 | 6800–9600 | 5400–7700 | ......... |
| 80 | 200 | 48 | 1 1/4–1 7/16 | 11–12 | 12800–20300 | 7500–12500 | 5950–9750 | ......... |
| 85 | 210 | 52 | 1 5/16–1 1/2 | 10–11 | 13900–22600 | 8100–13600 | 6450–10600 | ......... |
| 90 | 225 | 54 | 1 3/8–1 5/8 | 10 | 15100–26500 | 8800–14900 | 7000–11300 | ......... |
| 95 | 250 | 55 | 1 1/2–1 13/16 | 10 | 17600–30500 | 10300–18000 | 8200–14000 | ......... |
| 100 | 265 | 60 | 1 5/8–1 15/16 | 10 | 20200–35000 | 11800–20600 | 9400–16000 | ......... |

*For converting millimeters into inches, see table on page 1538 of MACHINERY'S HANDBOOK, sixth and later editions.

†Load ratings of commercial bearings vary considerably for different makes. This table is intended only as a general guide in preliminary designing. The exact rating should be obtained from the manufacturer of whatever bearing is to be used.

MACHINERY'S Data Sheet No. 249, New Series, May, 1933

## LOAD CAPACITIES OF THRUST BALL BEARINGS

| Bore Diameter, Inches | Outside Diameter, Inches | Ball Diameter, Inches | Number of Balls | R.P.M. and Approximate Range of Thrust Loads, in Pounds, for Different Makes* | | | |
|---|---|---|---|---|---|---|---|
| | | | | 100 | 300 | 500 | 1000 |
| 1/2 | 1 9/32 | 1/4 | 8 | 450<br>750 | 300<br>450 | 275<br>350 | 200<br>240 |
| 5/8 | 1 13/32 | 1/4 | 8–10 | 500<br>900 | 330<br>530 | 300<br>400 | 200<br>300 |
| 3/4 | 1 17/32 | 1/4 | 10–12 | 570<br>900 | 420<br>530 | 350<br>400 | 280<br>290 |
| 7/8 | 1 21/32 | 1/4 | 11–12 | 630<br>1000 | 440<br>600 | 400<br>475 | 290<br>320 |
| 1 | 1 25/32 | 1/4 | 12–14 | 700<br>1000 | 500<br>600 | 425<br>475 | 320<br>335 |
| 1 1/8 | 1 29/32 | 1/4 | 12–15 | 750<br>1000 | 550<br>600 | 460<br>500 | 320<br>360 |
| 1 1/4 | 2 3/32 | 9/32–5/16 | 13–14 | 1150<br>1400 | 750<br>875 | 650<br>730 | 450<br>570 |
| 1 3/8 | 2 7/32 | 9/32–5/16 | 14 | 1200<br>1400 | 800<br>875 | 650<br>730 | 450<br>570 |
| 1 1/2 | 2 11/32 | 9/32–5/16 | 14–16 | 1300<br>1400 | 800<br>940 | 650<br>850 | 450<br>600 |
| 1 5/8 | 2 15/32 | 9/32–5/16 | 15–18 | 1300<br>1580 | 900<br>1000 | 700<br>950 | 500<br>675 |
| 1 3/4 | 2 11/16 | 5/16 | 16–17 | 1470<br>1800 | 970<br>1060 | 820<br>890 | 570<br>700 |
| 1 7/8 | 2 13/16 | 5/16 | 16–18 | 1470<br>1800 | 1030<br>1060 | 820<br>980 | 570<br>700 |
| 2 | 2 31/32 | 5/16 | 16–18 | 1400<br>1800 | 900<br>1100 | 825<br>950 | 570<br>730 |
| 2 1/4 | 3 11/32 | 3/8 | 16–19 | 2150<br>2400 | 1400<br>1550 | 1100<br>1400 | 750<br>1000 |
| 2 1/2 | 3 23/32 | 7/16 | 16–19 | 2700<br>3200 | 1700<br>2100 | 1400<br>1900 | 950<br>1400 |
| 2 3/4 | 4 1/32 | 7/16 | 16–20 | 3000<br>3400 | 1700<br>2200 | 1400<br>2000 | 950<br>1450 |
| 3 | 4 3/8 | 1/2 | 16–20 | 3600<br>4400 | 2100<br>2900 | 1650<br>2700 | 1200<br>1900 |
| 3 1/2 | 5 1/16 | 9/16 | 18–20 | 4700<br>5600 | 2800<br>3700 | 2200<br>3400 | 1500<br>2400 |
| 4 | 5 13/16 | 9/16–5/8 | 18–22 | 5400<br>7300 | 3300<br>4800 | 2600<br>4400 | 2400<br>3200 |

*Load ratings of commercial bearings vary considerably for different makes. This table is intended only as a general guide in preliminary designing. The exact rating should be obtained from the manufacturer of whatever bearing is to be used.

MACHINERY'S Data Sheet No. 250, New Series, May, 1933

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# Welding From the Designer's Point of View

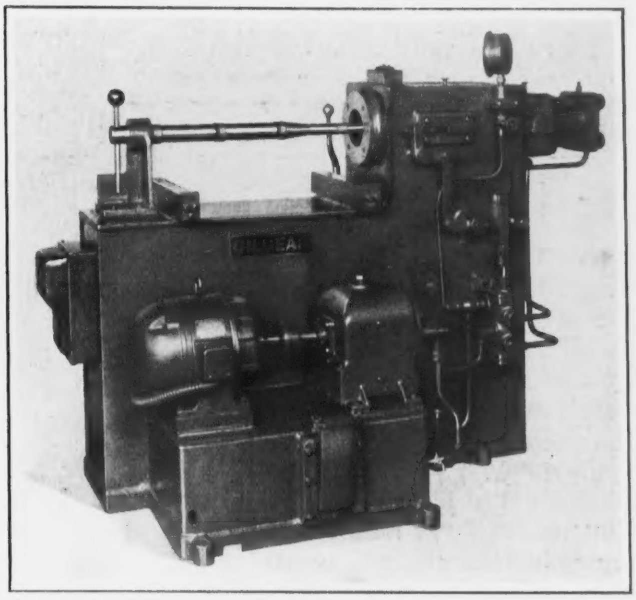



Fig. 1. Machine of Welded Steel Construction in which a Mistake in Height was Rectified by Cutting Several Inches of Material from Between the Base and Headstock and Welding the Headstock Back in Place

### Some of the Advantages Derived from the Welding Process that Are of Especial Interest to the Designer of Machinery

By CHARLES O. HERB

ONE of the greatest advantages of the welding process to the designer of machinery is the latitude that it allows him in his work. He can use his imagination freely in developing a design and need not stick to hide-bound traditions. Mistakes that a designer might make in a welded structure can be more easily rectified, and so he can approach his problems in a bolder frame of mind, producing designs radically different from those used under similar conditions in the past. This freedom does not exist to the same extent in cases where patterns and castings are involved.

If the first lot of a standard machine is not entirely satisfactory, the next lot can be improved with little or no cost beyond that incurred in the drafting-room. Thus, the use of the welding process in the construction of standard machines facilitates the development of the best designs.

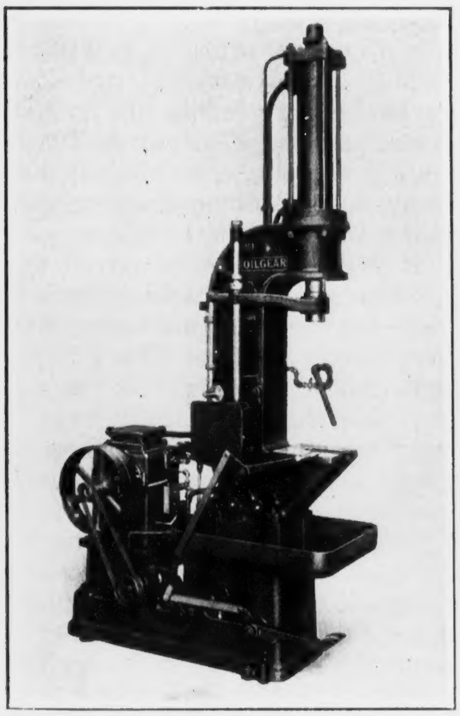



Fig. 2. Broaching and Assembling Press of Cast Construction on which There are Many Exposed Parts, Including Pulleys, Belts, Levers, Rods, and Piping

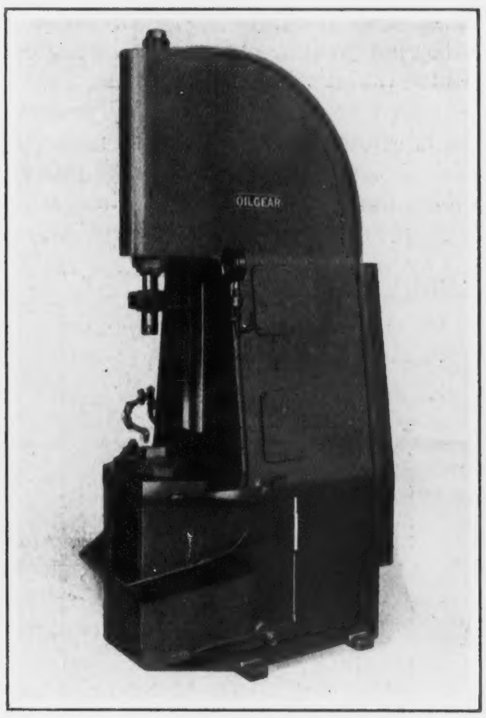



Fig. 3. Welded Machine Designed for Same Purpose as Equipment Shown in Fig. 2. Note Improved Appearance Obtained by Enclosing Working Parts

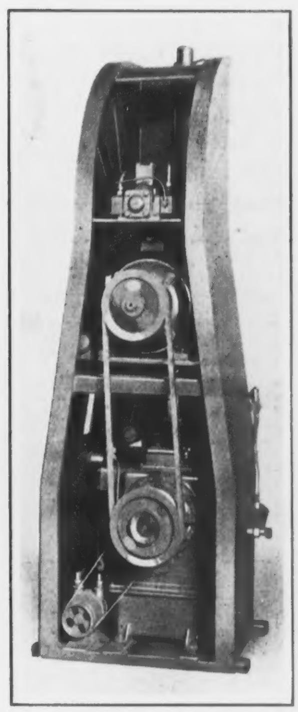


Fig. 4. How Machine in Fig. 3 Appears from the Back with Cover Plates Removed

There is a third advantage of particular importance to the designer—many designs that would not be practicable if cast, can be welded. Ribs, walls, and pads can be located in the most convenient places.

### How One Mistake Was Easily Rectified

The ease with which mistakes in welded structures can be corrected is illustrated by Fig. 1. When the machine shown had been completed, it was discovered that the customer had specified the distance from the floor to the center of the headstock 2 1/2 inches more than was wanted. This mistake was rectified by cutting off the headstock about 5 inches above the point where it joined the base, cutting off 2 1/2 inches of material from the neck which projected above the base, and finally welding the headstock back in place. The outer support on top of the base was, of course, cut down and welded in similar fashion. After proper filling in and painting, the alterations became practically unnoticeable.

### Welding Frequently Improves the Appearance of a Machine

How welding often enhances the appearance of a machine is illustrated by Figs. 2 and 3. The first of these illustrations shows a hydraulic press for assembling, broaching, forcing, and similar operations. All the larger parts, such as the base and column, are castings, and, with this design, numerous parts, including levers, links, pulleys, belts, and piping, are, of necessity, exposed to view. It is of interest to compare this equipment with the "Streamline" press of welded construction illustrated in Fig. 3, which has been developed for the same class of work.

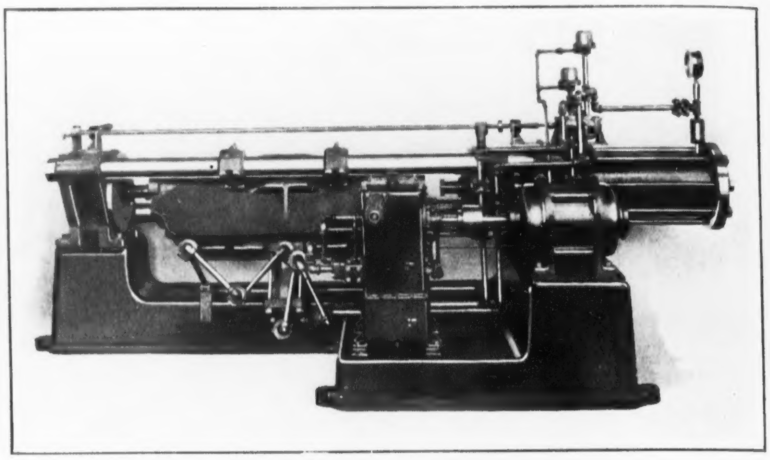


Fig. 5. Rear View of a Truck-axle Assembling Press with Base, Work-fixture, and Other Parts Made from Cast Iron

Because this second machine is of welded steel construction, it was possible to design the base and column in such a way that it encloses practically all other parts. This design would be impractical with castings, because of the pattern and casting costs and the weight of the machine. Fig. 4 shows the construction of the machine from the rear, the cover plates having been removed to show the hydraulic pump, driving motor, and operating valve.

Two horizontal machines of cast and welded construction, respectively, are shown in Figs. 5 and 6. These machines are presses, designed for assembling motor-truck axles. Both are equipped with an automatic clamping fixture which is operated hydraulically in conjunction with the assembling ram.

The fixture and base of the machine in Fig. 5 are iron castings, as well as some other parts. On the machine shown in Fig. 6, the base, fixture, and most of the other parts are welded, although several castings were used because the patterns were on hand. It will be generally agreed that the appearance of the welded machine is equally as good as, if not better than, that of the other machine. It is interesting to note how much heavier the cast fixture is than was necessary.

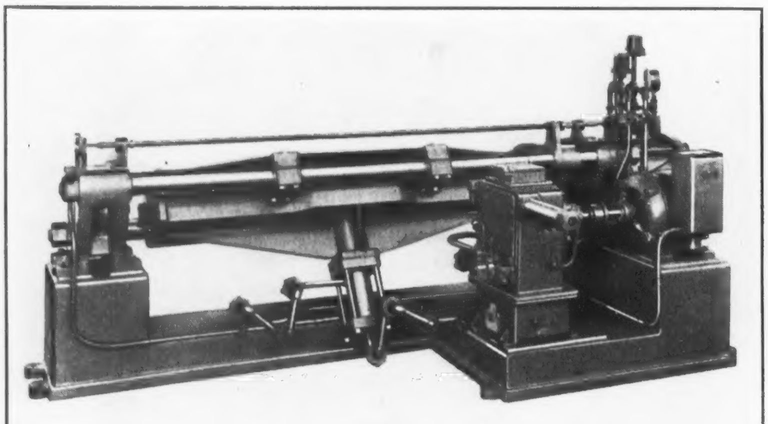


Fig. 6. Another Truck-axle Assembling Press in which the Base and Work-fixture are of Welded-steel Construction

Welded machine parts are sometimes pointed out as being too straight and stiff in appearance. This effect can often be avoided by welding plates together at slight angles. Then too, welded structures need not be made entirely of plates and structural shapes; they may also include stampings, castings, drop-forgings, bent pieces, etc. Sharp corners can be ground off to avoid stiffness. After all, it is not necessary to adhere to old ideas of appearance—the ideas as to what looks well are frequently matters of habit and subject to change.

### Care Must be Taken Not to Specify Too Much Welding

While a designer of welded machines is relieved of all consideration of the patternmaker and molder, he must not design parts in such a way that excessive welding becomes necessary. If he does, the gains obtained through the elimination of patterns, and the other advantages derived from welding, will soon be lost. On the other hand, if the design is good, the welded structure is often less expensive than a casting made from patterns already on hand.

There are, of course, instances when it is not desirable to substitute a welded part for a casting. For example, the pump housings used by the Oilgear Co. are cast because they are cheaper. Some parts are cast in order to get cored oil passages. Castings are also used in cases where cast iron is desired as a bearing metal.

When large surfaces must be machined, it is important to remember that cast iron can be finished more quickly than steel. At the same time, it must also be remembered that welded structures can be filled and painted at about 40 per cent less cost than castings, and so higher costs in the machine shop can often be counterbalanced in the painting department.

In the preparation of this article, valuable assistance was given the author by J. P. Ferris, chief engineer of the Oilgear Co., Milwaukee, Wis.

# Tendencies in German Machine Tools as Noted at the Leipzig Fair

The effects of present industrial conditions were quite in evidence at the machine tool exhibition at the recent Leipzig Fair in Germany. New designs were less numerous than in recent years, although in most of the machines exhibited improvements in detail were noted. On the whole, the same tendencies as characterize American machine tools at the present time are guiding German designers.

The effect of the new carbide tools on the design of shop equipment was quite marked. Many machines had wider speed and feed ranges, and better provisions for chips. Wherever possible, force-feed lubrication appears to be used. The weight and rigidity of the machine beds and frames have been increased. There was little evidence, however, of the use of welded construction for machine tool beds. On the other hand, there is a strong tendency to replace ordinary cast iron by special alloy cast irons containing nickel and chromium.

A feature particularly prominent at the exposition was the increased adoption of hydraulic, pneumatic, and electric chucks for holding work. Dial-type indicators were observed in increasing numbers, enabling the progress of operations to be observed without stopping the machine. Automatic size-control was also available in many instances on quantity-production machines.

Obviously, hydraulically operated machines would be in evidence. In this group were found especially milling machines, shapers, grinding machines, and cold-sawing machines. In milling machines, the most noteworthy tendency, perhaps, is the effort to equip standard machines with special attachments, making them, for the time being, special or single-purpose machines. Other innovations were largely in the driving mechanism, the arrangement of the built-in motor, and the drive between the motor and the spindle.

The recognized advantage of carbide tools for obtaining a high finish with high cutting speeds and fine feeds, together with a high degree of accuracy, has prompted the design of several precision boring machines.

Coining presses, for forging parts to accurate dimensions, have been developed along the same lines as in this country. Engraving machines especially suitable for die and mold work, employing a three-dimensional pantograph system, have been highly developed; and, of course, in the field of devices for measuring and inspection, many new developments were to be seen. These devices did not involve any new principles, but rather applied well-known principles in achieving accuracy and simplicity of measuring or inspecting.

* * *

### The World's Greatest Bridge

The new Golden Gate Bridge at San Francisco, on which work has just been started, will have the longest clear span in the world—4200 feet. This is nearly three times the length of the span of the old Brooklyn Bridge—for many years the eighth wonder of the world—and is 700 feet longer than the greatest present span—that of the George Washington Bridge over the Hudson River at New York.

The minimum vertical clearance at the center of the bridge will be 200 feet. The towers will be 740 feet high and 120 feet wide at the bottom—the highest and largest bridge towers in the world. The steel in the two towers alone will weigh more than the steel in the entire Quebec Bridge. The two main cables will be slightly over 3 feet in diameter each, and 7660 feet long between anchorages. They will contain 27,572 separate wires and will weigh 11,000 tons.

The live load capacity of the bridge will be 12,700 tons, equivalent to six solid lanes of ordinary vehicles and both sidewalks fully loaded for the full length of the span.

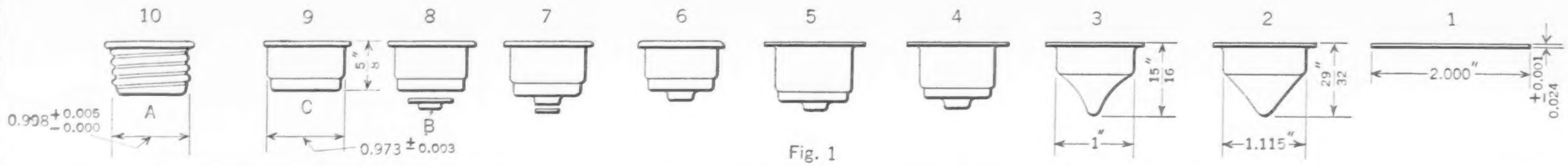


Fig. 1

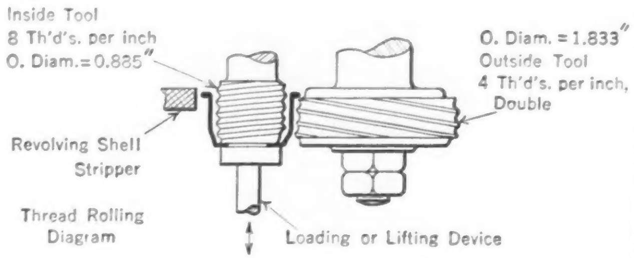


Fig. 2

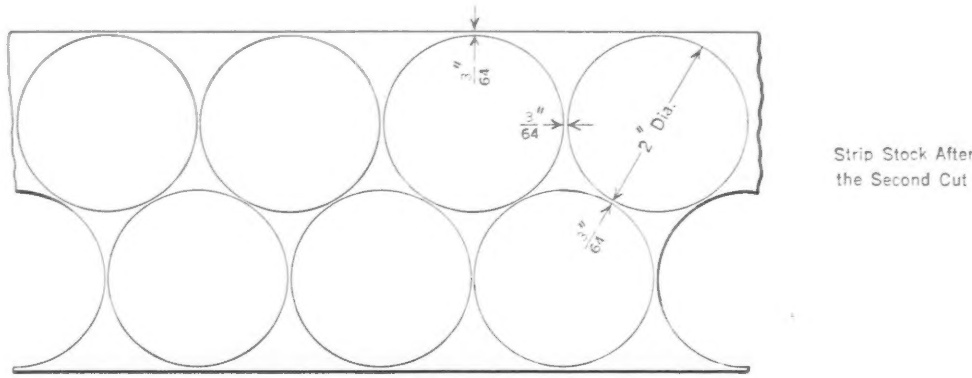


Fig. 3

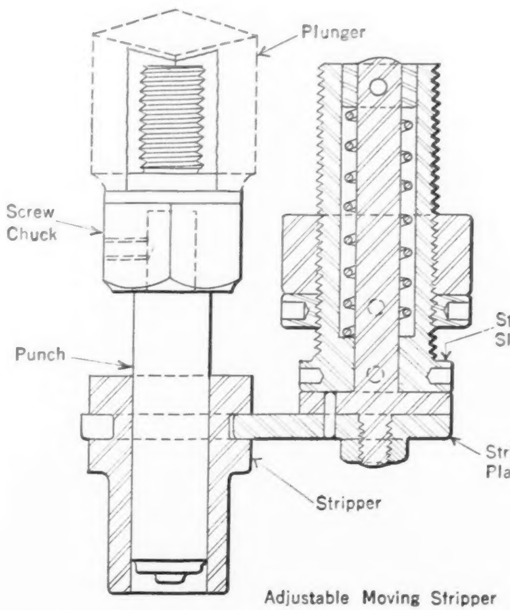


Fig. 4

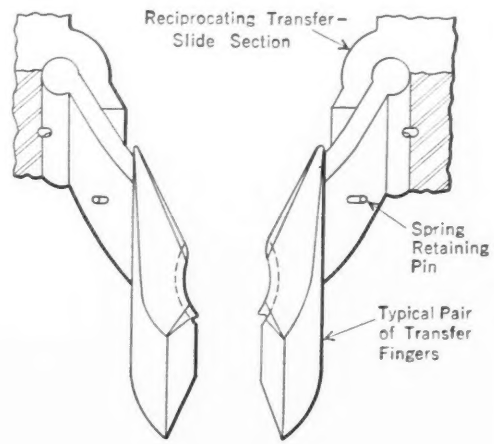


Fig. 5

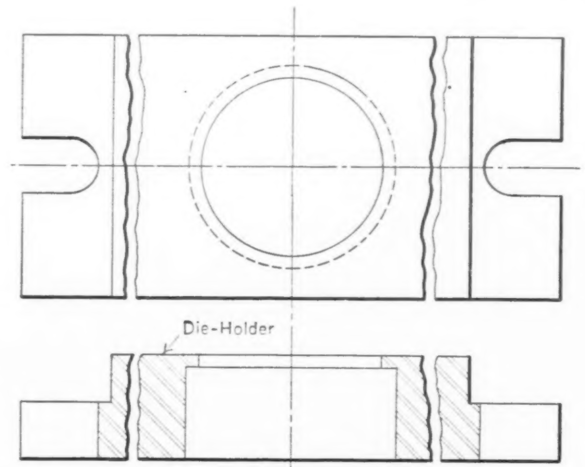


Fig. 6

**Fig. 1.** Evolution of Threaded Brass Shell as Produced on a Ten-plunger Eyelet Press and Automatic Threader. **Fig. 2.** Details of Tools Used on Automatic Threader. **Fig. 3.** Economical Spacing Obtained by Running Stock through Blanking Die Twice. **Fig. 4.** Details of Adjustable Stripper-actuating Device Used on Eyelet Machine. **Fig. 5.** Transfer Fingers Used in Transferring Work from One Die to Another on Eyelet Press. **Fig. 6.** Holder for Dies Shown in Fig. 7

# Nine Press Operations per Stroke at Ninety Strokes per Minute

**Eyelet Press and Shell Threader Equipped for High Speed and Simultaneous Production of Threaded Shells and Washers**

By EDWARD LAY

THE threaded shell *A* and the washer *B* shown in Fig. 1 are produced simultaneously on an eyelet machine operated in conjunction with an inclined shell threader. The average production in an eight-hour day is 38,000 pieces of each kind, the washer *B* being punched out from the bottom of shell *A* at the eighth operation. With this equipment, all operations are performed by one unit. The tools are simple, and they can be replaced quickly and at small cost when worn. The possibilities of such equipment, with respect to the economical production of a large variety of drawn, pierced, formed, and threaded shells, become evident when observing the operation of the tools illustrated.

The pieces *A* and *B* are used for sealing the openings of various liquid containers and hot water bags. The part *A* is assembled in the opening of the rubber bag or container and provides the thread into which a threaded stopple is screwed. The small piece *B* serves as a washer for holding a rubber washer in place at the end of the threaded stopple that fits into shell *A*.

The punches and dies for performing the operations indicated in Fig. 1 are illustrated in Fig. 7. The work passes from right to left, as indicated by the arrangement of the illustrations. The punches are threaded to fit the cam-actuated plungers of the Waterbury-Farrel ten-plunger eyelet machine on which the blanking and shell-forming operations are performed. The die members are secured to the machine by holders like the one shown in Fig. 6.

The tenth position on the machine is used for automatically transferring the drawn and pierced shells to a Waterbury-Farrel automatic shell threader equipped with the thread-rolling tools shown in Fig. 2. Thus, the two machines are operated as a single unit by one man. The operation of the complete unit through the eleven stages required to produce the parts is described in the following paragraphs.

The metal in strip form is fed to the die by a pair of intermittent ratchet feed rolls. Lubrication, by a constant dripping of cutting compound on the blanking punch, is provided by a pump. At the first stage, the blanking punch descends and cuts out the blank on die *A*, Fig. 7, carrying it through the die into a pocket *B* in the transfer slide *C*. The transfer slide is then moved to the left by means of a cam, carrying the blank to the second stage. Here the blank dwells while the punch descends and draws it through the transfer slide and into the first drawing die *D*. The transfer slide then recedes, and on the up stroke of the second plunger, an ejector *E*, actuated by a cam on the lower shaft, pushes the shell out of the die. From this position, the shell is stripped off the punch by thimble *F*, so that it rests in a pair of fingers held in the transfer slide, which are similar to those shown in Fig. 5.

The punch continues upward until it clears the top of the shell—see Fig. 4. The thimble *F*, Fig. 7, serves also as a pressure pad and blank-holder. It is actuated by a cam on the lower shaft and two levers connected by an adjustable connecting link. The first drawing punch is knurled at the curved contour *G* in order to obtain a good grip on the metal. Without this grip, it would be impossible to obtain such a deep draw of the shell at one stroke.

The next advance of the transfer slide carries the shell to the third stage and brings a new blank to the second stage. These cycles are repeated until the work is completed. The strip stock which passes through the die is wound up on a reel at the back of the press ready to be fed to the blanking die a second time. The staggered positions of the blanks cut from the stock by the two passes through the die are shown in Fig. 3.

At the fourth stage, the shell is formed into its semi-final shape. At the fifth stage, the shell flange is trimmed by the ring *H*. The trimmings *T* are allowed to accumulate on the knurled trimming ring-holder *I* until they come in contact with the scrap cutters *J*, when they are cut apart. The scrap pieces are collected by the shield *K* and a stream of compressed air forces them backward into a chute leading to a container.

The curling of the flange and the final forming of the shell body is accomplished at the sixth stage in die *L*. The strippers for this operation are only 1/2 inch wide and are guided in grooves at the left- and right-hand sides of the curling punch holder. The finish-curling or beading of shell *A* and the piercing of piece *B*, Fig. 1, are performed at the seventh stage. At the eighth stage, the finished washer *B* is blanked out of the bottom of the formed shell. The hole in the bottom of the shell is enlarged to the required size at the ninth stage. At the tenth stage, the completely drawn shell is transferred to the automatic shell threader by a cam-actuated pusher. Compressed air is applied just before the shell reaches the threading position, to avoid jamming in the curved part of the transfer chute.

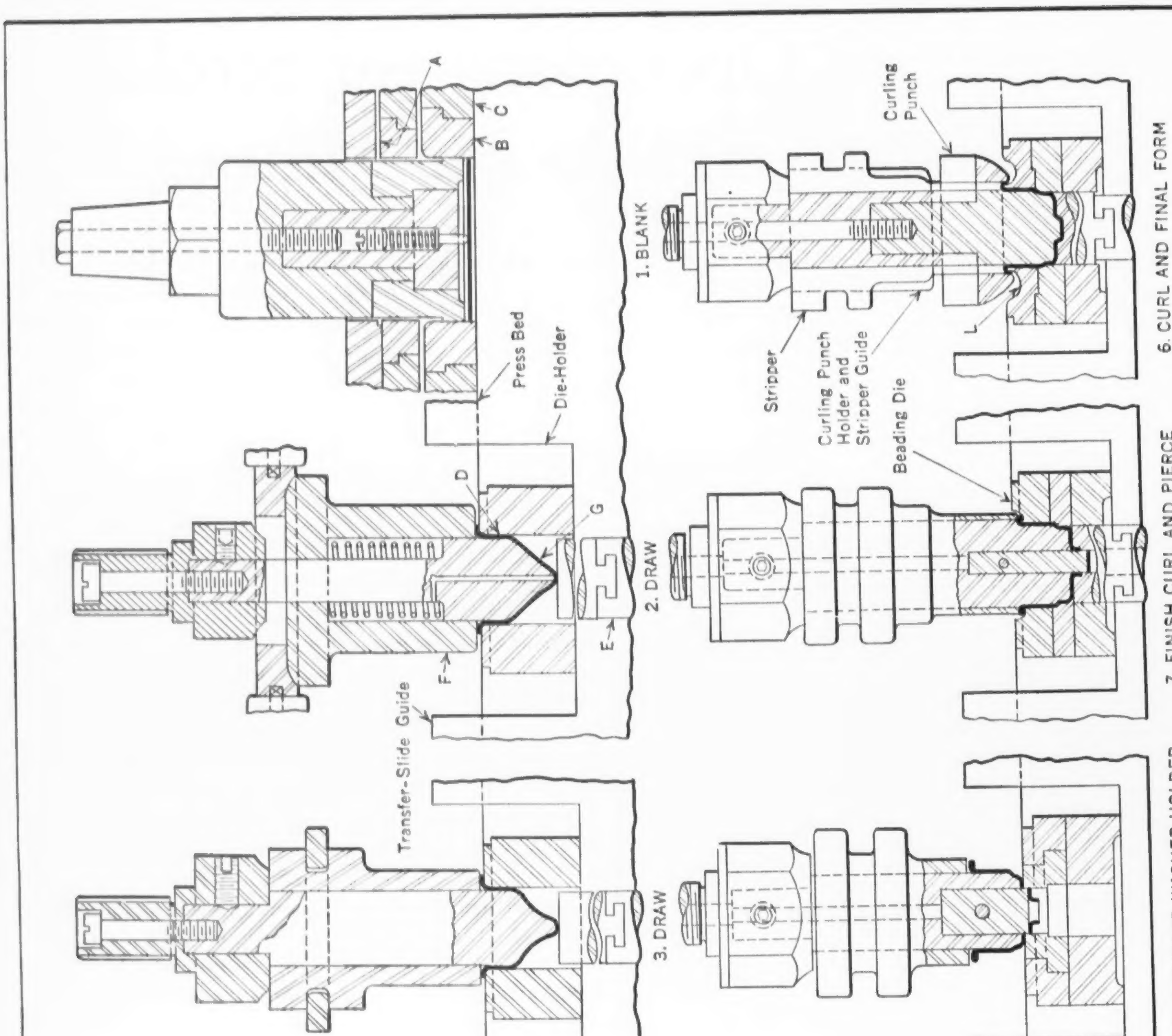



**Fig. 7. Punches and Dies Employed on Eyelet Press in the Production of Parts A and B, Fig. 1**

A feeding finger carries the shells from the transfer chute to the center of the tools, and a lifting device—see Fig. 2—pushes them over the inside thread-rolling tool at the eleventh stage. Both movements are spring-actuated, the return being cam-controlled and positive. The outside tool is next swung into contact with the shell and the threads are formed by applying the required rolling pressure. The arm in which the outside tool is mounted is cam-actuated. It is lifted, after the operation, by a spring that holds the roll against the cam.

The stripping or unscrewing device consists essentially of a non-metallic roll, which is much larger in diameter than the shell and is driven in a counter-direction at high speed. The roll is swung into contact with the revolving shell by spring pressure, thus stopping the rotation of the shell and unscrewing it from the revolving arbor so that it drops into a chute leading to a receptacle beneath the machine. Thread gages are used frequently to check up the size of the work, which is held within close limits.

***The National Acme Co., Cleveland, Ohio, evidently believes in replacing old equipment with modern machinery. The illustration shows a pile of automatic screw machines in the company's yard, destined to be scrapped. F. H. Chapin, president of the company, says: "We consider it a hopeless attempt to meet modern competition with obsolete machine tools, even though they may be in good condition. We not only recommend the replacement policy to our customers—we believe in taking our own medicine."***

## Chicago Machine Shop Practice Meeting

The Chicago Section of the American Society of Mechanical Engineers held a Machine Shop Practice Meeting on March 30, at which four papers of special interest in the machine shop field were read: E. Gairing, president of the Gairing Tool Co., Detroit, Mich., spoke on "Design and Construction of Counterbores and Multiple-operation Tools"; C. E. Stryker, vice-president of the Ramet Corporation of America, North Chicago, Ill., dealt with the subject "Ramet—Tantalum Carbide"; "Inserted-blade Boring and Reaming Tools" was the subject covered by D. E. Van Deusen, vice-president and general manager of the Kelly Reamer Co., Cleveland, Ohio; and "High-speed Tapping and Grinding" was dealt with by H. Goldberg, vice-president of the R. G. Haskins Co., Chicago, Ill. In connection with the latter paper, there was a demonstration of high-speed tapping at four times the speeds usually recommended. There was also an extensive exhibit of different types of tools.

The following societies participated: The Western Society of Engineers, the Chicago Engineers' Club, the Superintendents' and Foremen's Association, the American Machinery and Tools Institute, the Illinois Manufacturers' Association, and the Chicago Purchasing Agents' Association.

# Chromium Plating Finds New Applications in the Machine Shop

By N. H. McKAY, Vice-President and General Manager, and
C. F. BONNET, Metallurgical Engineer, U. S. Chromium Corporation

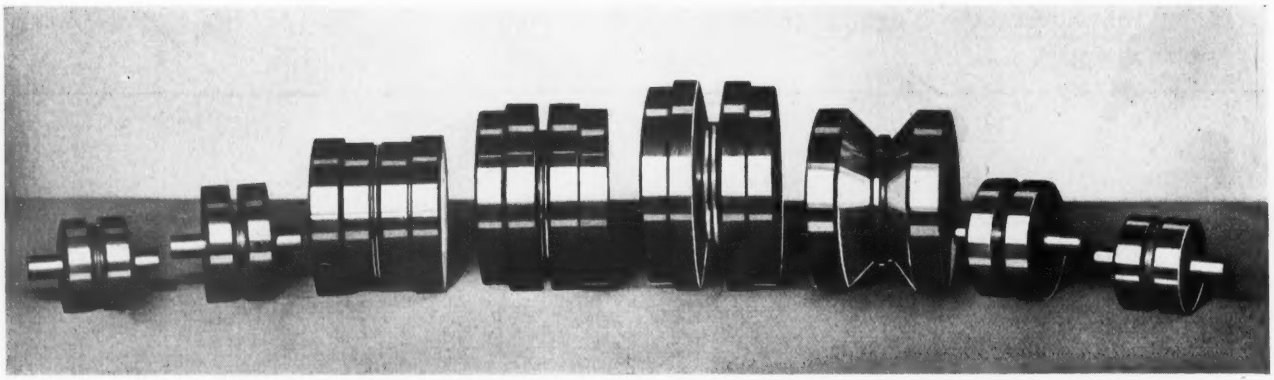


Fig. 1. A Set of Chromium-plated Rolls Employed in Forming Metal Door Parts

THE use of electro-deposited chromium has increased rapidly within the last few years. We now see chromium plating on the trimmings of nearly every automobile, the plumbing fixtures of every modern bathroom, and the hardware and decorative metal work of all modern buildings. For this application, the article is plated with a light deposit of chromium, after having been plated with copper or nickel, or both. Chromium has achieved great popularity as a decorative metal, because of its high silvery luster, which does not tarnish. It also has other properties which have caused a tremendous change in many types of industrial equipment. For such uses, chromium is deposited directly on the base metal without undercoats of copper or nickel.

The hardness of electro-deposited chromium cannot be readily measured by ordinary methods, such as the Brinell or Rockwell hardness tests, which depend on the penetration of a ball or cone to an appreciable depth. Scratch comparisons, such as are used in connection with minerals, are compared on Mohs' scale, and give electro-deposited chromium a hardness rating of 9, as compared with 10 for the diamond. Such tests, however, are to a large extent subject to the human element, and reproducible results are hard to obtain.

A far superior method of testing surface hardness has been developed by Dr. R. J. Piersol in the laboratories of the U. S. Chromium Corporation, in Pittsburgh. This method consists essentially of the measurement of the time required for a slow-speed abrasive wheel, held against the test piece at a constant pressure, to reach a penetration of 0.001 inch. Tests made by this method are reproducible, and show not only that chromium plate is considerably harder than casehardened steel, but that it varies widely in hardness itself, depending on the method of deposition.

These methods can be so controlled as to give deposits of chromium that are consistently "diamond hard" directly on a base metal. It may be well to mention here that although chromium offers excellent protection against purely abrasive wear when deposited on such soft metals as copper or mild steel, it has a tendency to become deformed when high pressures are applied to it. Thus, where surfaces are subjected to considerable pressure, it is necessary to select a material for plating that is hard enough and strong enough to resist such deformation in service. This is done by reinforcing the hard protective chromium coating with a strong underlying material.

Chromium has a very low coefficient of friction. The static coefficient of friction for steel on chromium-plated steel is 0.17, and the sliding coefficient of friction is 0.16. This compares with a static coefficient of friction for steel on steel of 0.30 and a sliding coefficient of friction of 0.20. The static coefficient of friction for steel on babbitt is 0.25, and the sliding coefficient of friction 0.20, whereas for chromium-plated steel on babbitt, the static coefficient of friction is 0.15, and the sliding coefficient of friction 0.13. These figures apply to highly polished bearing surfaces. Articles that are to be chromium-plated in order to resist frictional wear should be highly polished before plating so that full advantage can be taken of the low coefficient of friction that is characteristic of chromium.

Chromium resists attack by almost all organic and inorganic compounds, except muriatic and sulphuric acids. It is not suitable for service when

either one of these acids is present in appreciable amounts. Chromium readily resists the corrosive action of such common corrosive agents as salt water, industrial atmospheres, sulphur compounds such as are present in oil refining processes, furnace gases, and products of combustion.

The melting point of chromium is 2930 degrees F., and it remains bright up to 1200 degrees F. Above this temperature, it forms a light adherent oxide, which does not readily become detached. For this reason, chromium has been used successfully for protecting articles that must resist high temperatures, even above 2000 degrees F. One of the unique properties of chromium is its high surface energy. This characteristic enables chromium to resist wetting. Thus, ordinarily sticky materials can be removed from a chromium-plated surface with ease. The low coefficient of friction of chromium is in a large measure due to this self-lubricating quality of high surface energy.

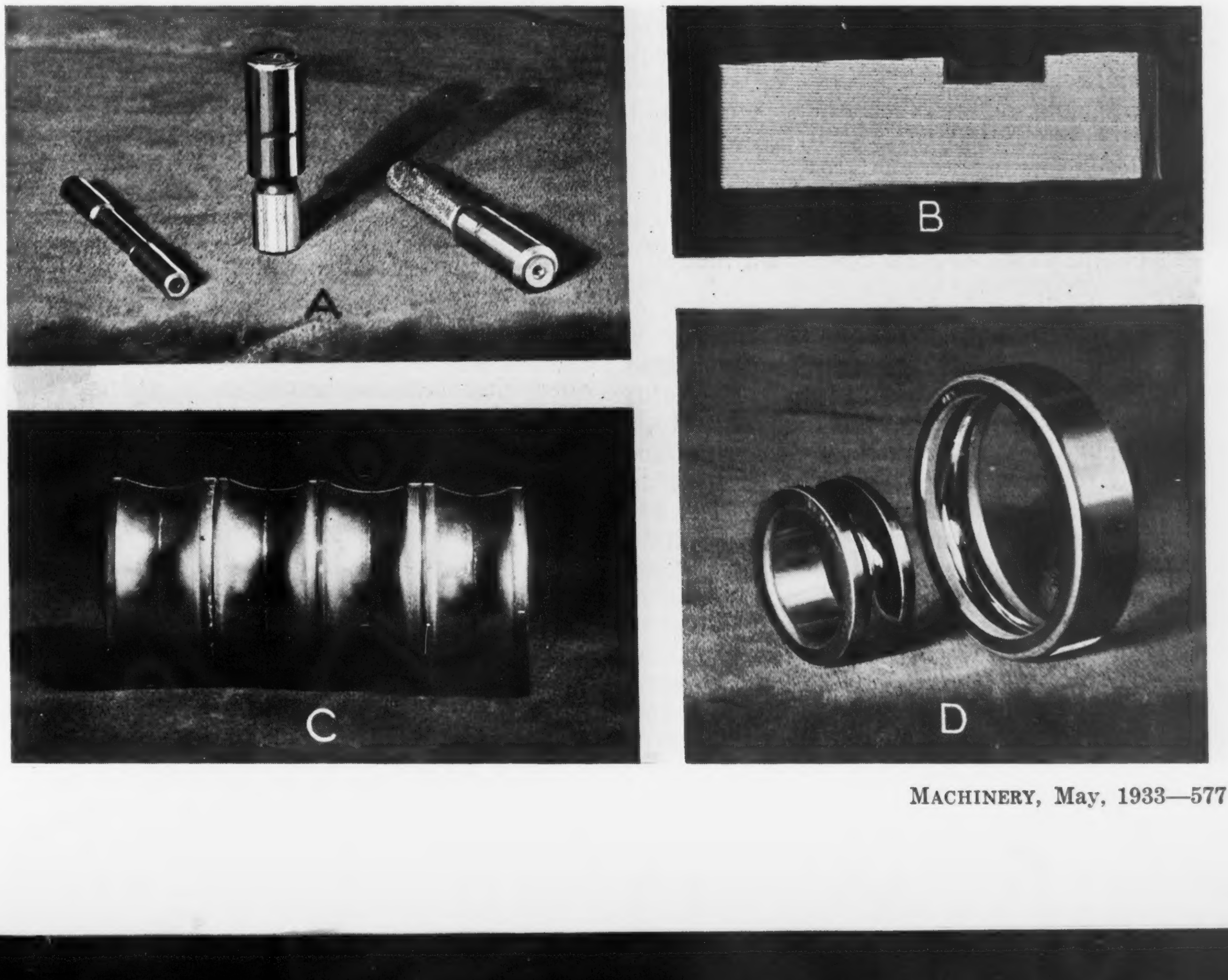
Chromium has been found very valuable in protecting metal surfaces against water, corrosion, and heat. The industries using chromium in their mill equipment, because of these properties, include the paper, rubber, plastics, glass, steel, textile, power, and food industries. Parts of mechanical equipment used in these and many other industries have been chromium-plated to advantage. The "hard chromium" process used for this work depends on the deposition of chromium directly on the base metal. Steel is generally the most suitable base for hard chromium plating, but copper, brass, bronze, nickel, and other non-ferrous metals and alloys have been used successfully in some applications. Chilled iron is an excellent base for chromium plating, but gray iron is not so satisfactory in many cases. Aluminum, zinc, lead, and tin are not satisfactory metals for hard chromium plating.

Successful results in chromium plating depend largely on the intelligent and skillful technical control of the plating process, due largely to certain characteristics of the chromium-plating solutions used. For this reason, hard chromium plating cannot be done successfully without a well trained and highly skilled operating staff and technical control.

### Chromium-Plated Guide Strips for Lathe and Planer Beds

Hard chromium plating is applied in machine shop work for two purposes—first, to provide a superior wearing surface on mechanical equipment,

Fig. 2. (A) Chromium-plating these Plug Gages Increased Their Life from Five to Ten Times. These Gages Can be Replated a Number of Times, Thus Further Prolonging Their Life. (B) One of a Pair of Chromium-plated Dies for Rolling Bolt Threads Cold. Chromium-plating Practically Doubled the Life of these Dies at an Additional Cost of from One-third to One-half the Cost of the Unplated Dies; (C) Small Rollers Used in Forming Copper Rivets Cold. Chromium-plating these Rolls Prevents their Picking up Copper Particles; (D) Chromium-plating Decreases Wear and Corrosion of Ball-bearing Races



and second, to prolong the life of metal-cutting tools. Machine shop equipment, from the lightest lathe to the heaviest planer, has wearing surfaces, such as shaft bearings and bed guides. The wear strips used in these guides are difficult to make in hardened steel and are very costly.

During the last few years, the U. S. Chromium Corporation, Pittsburgh, Pa., has been engaged in developing a guide wear strip of polished carbon steel, chromium plated. A number of sets of these guides have been in service for several years and have proved satisfactory in every way. The application of chromium has materially reduced the lubrication requirements and the guides have shown no wear up to the present time. This company holds patent rights on chromium-plated guides and is proceeding with their development.

### Advantages Gained by Chromium-Plating Various Machine Parts

The application of chromium to shaft bearings, either directly on the shaft or in a bushing, has resulted in reduced wear, better alignment, and lower lubrication and maintenance costs.

Feed-screws for lathe tool carriages have been successfully chromium-plated to prevent wear. The value of chromium is apparent in this application, particularly on automatic lathes and screw machines, where slight amounts of wear cause a great deal of trouble. Wearing parts on internal grinders, centerless grinders, and other machines where abrasive dust is present can be given increased life by plating them with hard chromium.

Chromium-plated cams are far superior to unplated ones, because with cams there is always a rolling or sliding friction and the effect of this friction is to change the shape of the cam. Since shape is essential for the correct operation of a cam, any measure tending to preserve the shape is important. Thus chromium, in supplying a surface with characteristically low friction and great hardness, is a logical structural component of a good cam.

### Plating of Tools Requires Specialized Study

The application of hard chromium to metal-cutting tools requires specialized study. Such widely varying results have been secured in this field that it is difficult to draw any accurate conclusions. Different machine shops using chromium-plated tools in essentially the same service, with all conditions practically the same, have reported widely varying results. One shop has secured twenty times the life of unplated drills or reamers by applying hard chromium to these tools. Another shop actually lost money because the longer life of the tool obtained from the use of chromium was not great enough to pay for the plating. What is the reason for these wide variations in the performance of chromium-plated tools? The answer will be found in the following paragraphs.

### Why Chromium-Plated Tools Do Not Always Meet Expectations

When chromium plating was first announced as an improved surface for tools, a great many users immediately sent a set of drills or taps to the nearest plater for hard chromium plating. Usually these plating shops are not equipped to produce a satisfactory job of hard chromium plating for industrial applications. Accordingly, the result of such tests has too often been a condemnation of chromium in general.

Secondly, there is often an impression that, if chromium has operated satisfactorily on drills used on iron castings, chromium-plated tools should be satisfactory for machining cast iron in general. This is not at all true, as each type of operation will have many factors of which any or all may vary. For example, in drilling cast iron, each shop may vary the speed, feed, or lubrication. Single or multiple drills may be used. All these factors have a definite effect. The variation in the physical properties of the materials having the same nominal characteristics is another factor that should be taken into consideration.

### Misconceptions Regarding Cutting Action of Chromium-Plated Tools

There is a natural feeling that on account of its hardness, chromium is valuable in adding hardness to the cutting edge of a tool. This is not the case; actually it becomes necessary to regrind the cutting edges on nearly all tools after plating. This grinding should be sufficient to remove all chromium from the edge. The important advantage of chromium is gained by having the chip bearing faces of the tool plated. Here the plating gives low friction, cooler operation, longer cutting life, and freer chip removal.

In this respect, every tool presents a slightly different problem. Here, again, an engineering study of each cutting problem must be made, supplemented by analogous performance data and tests made under actual operating conditions. In other words, the design of chromium-plated tools must follow the same procedure as the design of a tool made of entirely new material throughout.

After proper designing has determined the place where chromium can be used to advantage, skilled procedure and technical control in plating are necessary to insure a plate with properties on which the design has been based.

### Satisfactory Results Obtained with Chromium-Plated Tools

In general, chromium-plated tools have operated well, giving greatly improved performance on nearly all classes of materials, such as brass, bronze, copper, nickel, aluminum, cast iron, steel, plastics, asbestos compositions, and similar materials. In-

creased cutting life has been the result with chromium-plated drills, taps, reamers, files, broaches, tool tips, saws, thread chasers, and the like. Dies for stamping, drawing, hot-forging, die-casting, and for molding plastic materials have shown greatly increased life after being plated with hard chromium.

The value of chromium-plating plug and ring gages has probably been more thoroughly demonstrated than any other one application of this treatment. Gaging costs in automotive plants have been reduced over 50 per cent by the use of chromium-plated gages. The interesting part about this application of chromium is that a large part of the saving is due to the fact that not only do chromium-plated gages wear longer, but when worn over size, the chromium may be removed and the gage replated and reground to size. After replating, the gage goes into service as good as new. The same type of maintenance can be applied to reamers and other sizing tools.

### Reclaiming Under-Sized Parts by Plating

The process of reclaiming under-sized parts by chromium plating has met with a great deal of favor, due to the strength and hardness of chromium. This has been particularly true of heavy machine parts. Reclamation is customarily done when the work is not more than about 0.01 inch over or under size, but good deposits as heavy as 0.165 inch of chromium have been produced. Such extreme thicknesses, however, require a special process and are rather expensive.

Chromium has been used advantageously in pneumatic tool reclamation. The hammer barrels and valve-block bores of these tools, when worn over size, are chromium-plated and ground and lapped to the standard size. New standard size pistons are then fitted to the tool, and it is as good as new. Riveting hammers and chipping hammers reclaimed by this method have consistently lasted three times as long as new, unplated tools before they required replating. Piston and valve wear has been reduced by chromium plating. The high charges for carrying stocks of over-size parts usually included in the maintenance budgets have been eliminated through the use of chromium plating.

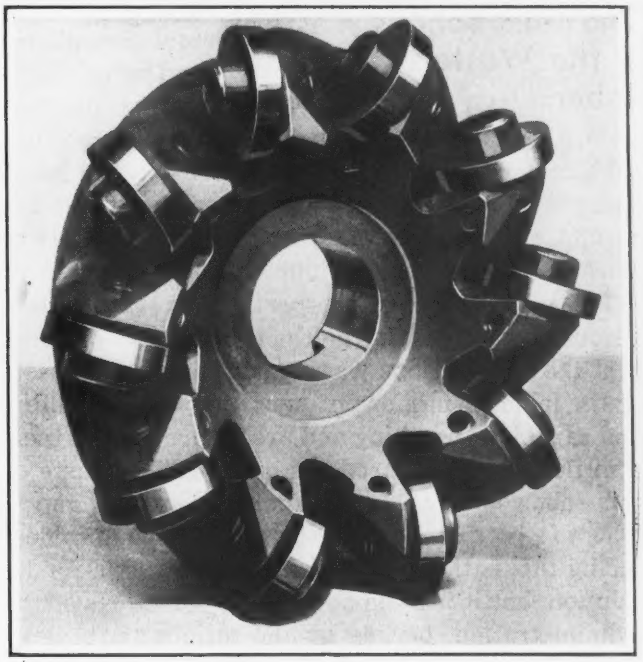
No definite attempt has been made here to estimate the increase in life that can be expected by chromium-plating tools. The reason for this is that, although consistent results are obtained for a certain operation in a given plant, the same results are not readily duplicated in similar operations in other plants, due to the uncontrollable variables previously cited. Such a statement as "ten times increased life" is not conclusive without more complete information as to service. It is, however, an established fact that hard chromium will show marked economies in many industrial applications where abrasive or frictional wear, heat, or corrosion are important cost factors.

The writers suggest that the only proper way to investigate the advantages of any hard chromium plating application is to consult a firm of qualified engineers specializing in industrial chromium plating. By a cooperative study of the problem with competent engineers, a combination of chromium with the materials being used can generally be evolved that will effect appreciable operating economies.

* * *

## Facing Cutter with Adjustable Circular Teeth

The object in using circular cutting teeth in the facing cutter shown in the accompanying illustration is to provide means for keeping the cutter in operation for a long time before regrinding becomes necessary. Each tooth is mounted on a central pin screwed into one of the body brackets, and is prevented from rotating during the cut by a hardened locking screw.



The Circular Cutting Teeth in this Facing Cutter are 1 1/2 Inches in Diameter and Can be Adjusted About Eighteen Times to Bring New Edges into the Cutting Position

When the working edges become dull, the locking screws can be loosened and the teeth turned through a small angle and again clamped in place. This brings new cutting edges into the working position. The relocating of the circular cutters can be repeated until the whole surface of each tooth has become dull. This cutter, which was illustrated and described in *Engineering*, has been developed by Samuel Osborn & Co., Ltd., Clyde Steel Works, Sheffield, England.

# EDITORIAL COMMENT

Frequently we hear it said that our present difficulties are due to the extravagance and waste that took place during our years of prosperity. This is hardly correct, if by extravagance and waste is meant that the people of the United States made use, to the fullest extent, of the goods that were manufactured. On the contrary, it was the continued and liberal use of these products that kept labor employed and made it possible for everybody to enjoy the material benefits that our industrial progress has made available.

Individuals are extravagant when they live beyond their income; but the nation as a whole cannot live beyond its income unless it borrows from abroad, and the United States did not do that. Whatever was consumed was first produced by industry and labor. The people of the United States consumed only the results of their own efforts; it is not possible to consume goods produced tomorrow.

## The Most Serious Waste is the Waste of Human Labor

It is not in times of prosperity that there is dangerous waste; it is during the periods of depression that the most serious waste takes place—the waste of the labor of millions of men and women, willing and capable of working and producing to meet their own needs and the needs of others. The waste of this labor is our greatest national extravagance. How to stop this waste is the most serious problem facing this nation. No one has any formula for its solution, but it is to be hoped that the efforts of the Administration, backed by the serious purpose of the entire nation, will produce results in the right direction. Self-reliance and courage have always been assets of the American nation. When a man or a nation believes that a difficulty can be overcome, the problem is half solved.

On page 593, a correspondent calls attention to a method whereby the shop library can be made to serve a very definite purpose. Many managers overlook the importance of their employes being well informed on the current developments in the industry in which they are engaged. They do not require their shop executives and engineers to keep constantly posted on developments in other plants through the medium of the technical journals. Yet to keep so informed should be considered one of the duties of any man holding a responsible position. The most capable and progressive men do this of their own accord; but there are always, in every shop, men who have latent powers of development, but who need encouragement—sometimes a little prodding—in order that they may be constantly alert to what is going on in their industry. It is these men who would receive the greatest benefits from the regular reading of mechanical books and journals, and who are most in need of assistance.

## The Shop Library Can be Made a Real Asset to Industry

Just as a manager in a plant is always on the lookout for improvements in his product, so he ought to be on the lookout for "improvements" in his organization; and one important improvement is the increased mental alertness, ability, and initiative that comes through the reading of technical journals that record industrial progress, and books that cover specific branches of industrial and engineering work. The establishment of a shop library makes it possible to realize this improvement at a very small expense; but it is not enough to *establish* the library—it is also necessary to see that it is *used*.

When the general manager buys a new hat, he does not go down Main Street looking for the cheapest hat he can find; he goes to a store with a reputation and he pays a good price for his hat, because he knows that quality cannot be obtained except by paying for it.

## Does the General Manager Buy the Cheapest Hat He Can Find?

He then proceeds to his office; but does he follow the same principle in buying machine tools and other equipment for his shop? If he is wise he does; but he is not always wise. Sometimes he seems to believe that in machine tools, and taps, and reamers, and cutters, and oil, and a hundred other items that are necessary for the successful running of a plant, the relation between quality and price no longer holds. Often he takes note of the price of the cheapest tool obtainable, and he expects that the makers of quality equipment should be able to meet that price. If buyers were consistent, they would apply the same reasoning to the purchase of machine shop equipment that they do to the buying of personal attire, furniture, and automobiles. It is not possible to get something for nothing, either in hats or in tools.

# Ingenious Mechanical Movements

***Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices***

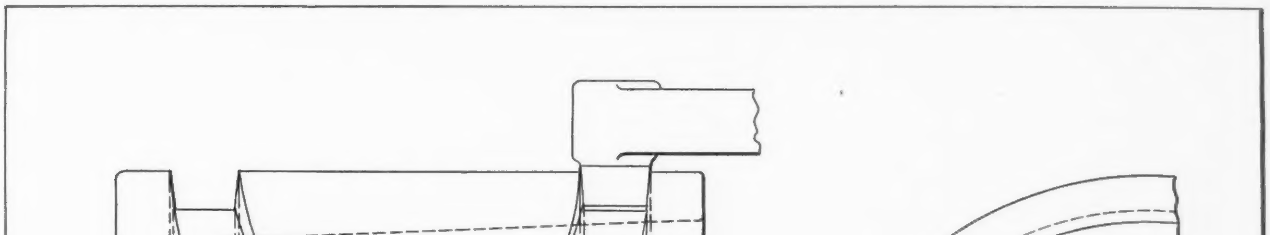
## Switching Arrangement for Cylindrical Cam with Intersecting Grooves

By J. E. FENNO

Cylindrical cams having intersecting roll grooves are sometimes used when a cam of small diameter is desired, or when two revolutions of the camshaft are required to one cycle of the follower. These cams have also found application in sewing machines, gas engines, etc. In the ordinary cam of this type, the break in the grooves at their intersection necessitates the use of a follower of special design, because a roll would become wedged at this point. The roll is usually replaced by an oblong shoe, the sides of which curve inward at the ends so that the shoe will be a sliding fit in any part of the groove.

This arrangement is not always satisfactory when a smooth action of the follower is required, owing to the increased clearance around the shoe at the intersection of the groove. Moreover, at this point, the pressure of the sides of the shoe against the corners of the groove causes a great deal of wear on both members. These objections are overcome, however, by the rather ingenious switching arrangement on the cam illustrated. It is entirely automatic and provides a continuous groove for the roll, regardless of which groove the roll is in.

The arrangement consists of the grooved plunger *A*, member *J* secured to the plunger shank, and the stationary cams *B* and *C*. These cams are mounted




Cam Having Two Grooves and an Automatic Switch at their Intersection

on the arm $F$ extending within the cored portion of the cylindrical cam and serve to rotate the plunger 90 degrees for every revolution of shaft $E$. Cam $C$ has a shank which is a sliding fit in a hole bored in the arm $F$. The shank is backed up by a coil spring to compensate for the interference of cam $C$ when engaging with member $J$. Pins $D$ lock the plunger in position after each indexing movement.

In the position shown, the lower end of plunger $A$ has engaged cam $B$. Further rotation of the cylindrical cam in the direction of the arrow will cause cam $B$ to force the plunger outward until pins $D$ have been withdrawn from holes $G$. The plunger is now free to rotate. As the cylindrical cam continues its rotation, the end of cam $C$ comes in contact with lobe $H$ on member $J$ and rotates the plunger 90 degrees. In this position, the pins $D$ are directly over another set of holes like those at $G$, and the plunger is seated through the action of the coil spring $L$ and locked in position by the pins as they enter these holes.

The groove in the plunger is now aligned with cam groove $K$ in which the roll is guided as the cylindrical cam continues to rotate. For each succeeding revolution of this cam, the indexing action of plunger $A$ is repeated, so that the plunger groove is always in line with the proper cam groove. In designing a cam of this type, it should be remembered that the cam grooves must cross at an angle of exactly 90 degrees; otherwise inaccurate alignment of the cam and plunger grooves will result. Hardened bushings in the cylindrical cam may also be provided for the indexing pins to reduce wear at these points.

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## Planetary Feeding Arrangement for Deep-Hole Recessing Tool

By WILLIAM KLINKOW

An ingenious application of planetary gearing to tool design is shown in Figs. 1 and 2. This tool is used in a radial drilling machine for milling, at a depth of 8 1/2 inches, an irregular recess in the ports of a steel forging, as indicated at $A$ in Fig. 3. Internal gear $A$ (Fig. 1) is fastened to the shank $B$, and meshing with this gear is the pinion $C$, secured to the end of the cutter shaft $D$. Endwise movement

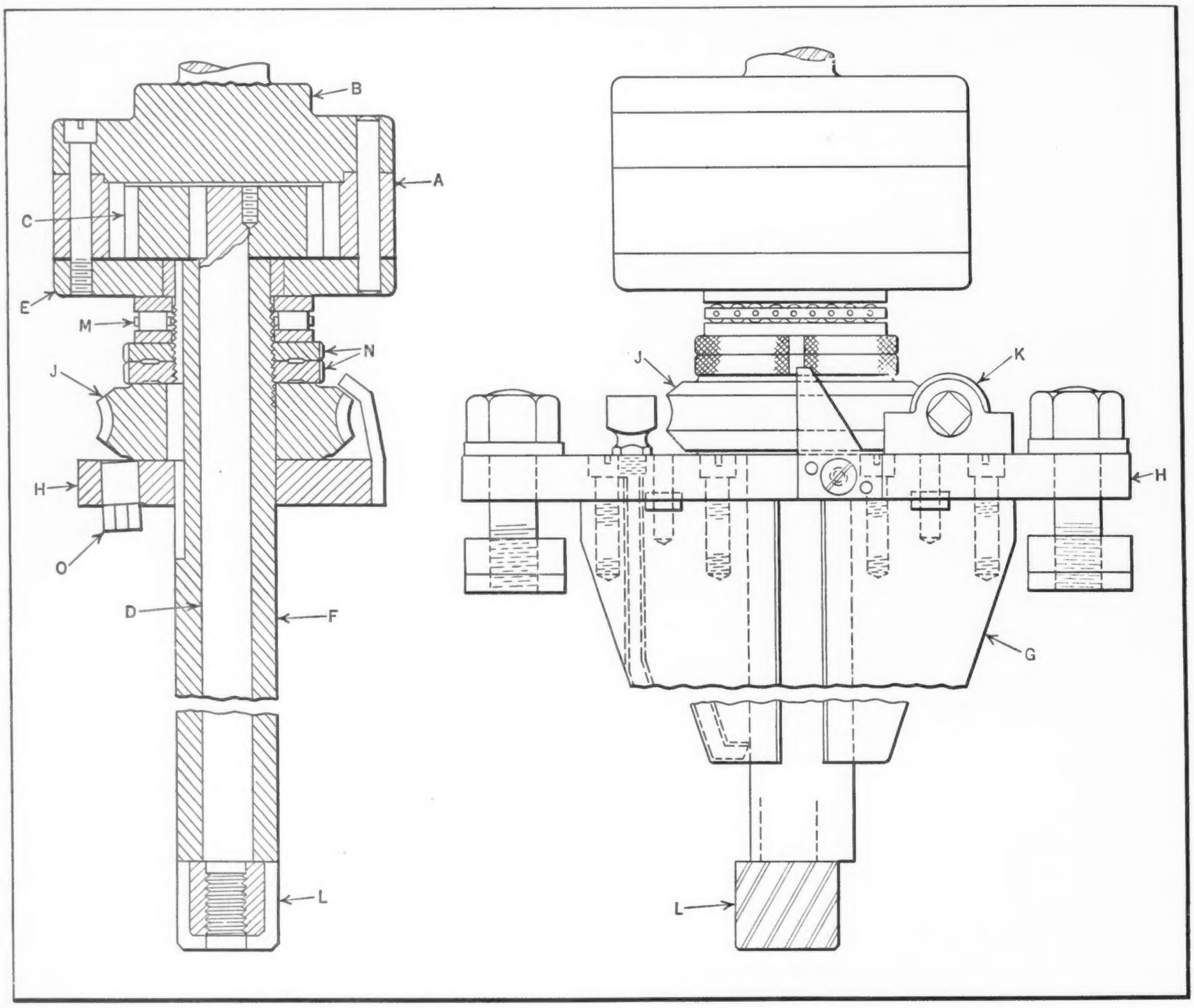



Fig. 1. Recessing Tool with Planetary Feed for Milling an Irregular Recess at a Depth of 8 1/2 Inches

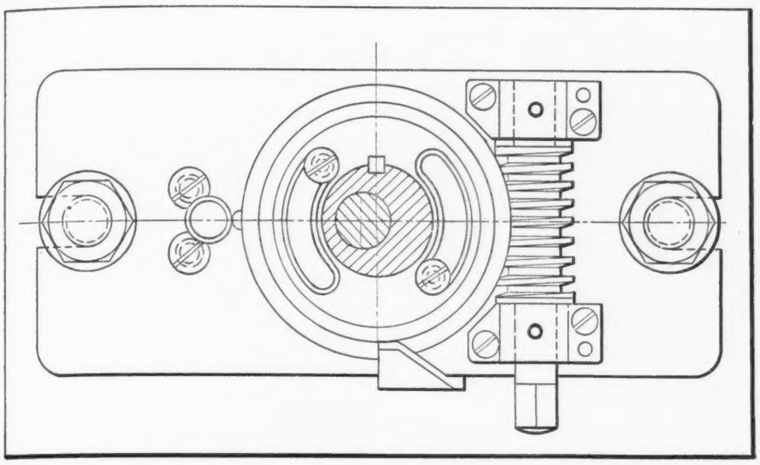


Fig. 2. Plan View of the Recessing Tool, Showing How the Cutter Shaft is Fed toward the Work by an Eccentric Sleeve

of both pinion and shaft is prevented by the retaining plate *E*.

The eccentric sleeve *F* provides a bearing for the cutter shaft and is supported along its length by the two jaws *G*. These jaws are secured to the plate *H*, upon which is mounted the worm-wheel *J*, which is keyed to the eccentric sleeve. Meshing with this worm-wheel is the worm *K*, which serves to rotate the eccentric sleeve for feeding the cutter *L* into the work. The thrust of the cutter is taken by the roller bearing *M* through the check-nuts *N* on sleeve *F*.

To recess the port *A*, Fig. 3, the cutter, offset in the position indicated in Fig. 1, is lowered to the bottom of the port, and the plate *H*, located by pin *O*, is fastened by T-bolts to the top of the forging. The jaws *G* are made slightly less in width than the port, so that they serve to centralize, as well as to support the eccentric sleeve. As the machine spindle rotates, the internal gear revolves about the pinion, rotating the latter with the shaft and cutter.

To start the cut, the eccentric is rotated by hand through the worm and worm-gear, a handwheel (not shown) being provided for turning the worm. As the eccentric sleeve rotates, the cutter is swung into the side of the port. The greatest depth of cut is reached when the worm-wheel has rotated 90 degrees, as indicated in Fig. 3 by the dot-and-dash circles representing the cutter. When the cut is completed, the worm-wheel is reversed to withdraw the cutter from the recess. The tool is then removed and set up in the next port, where the other recess is cut.

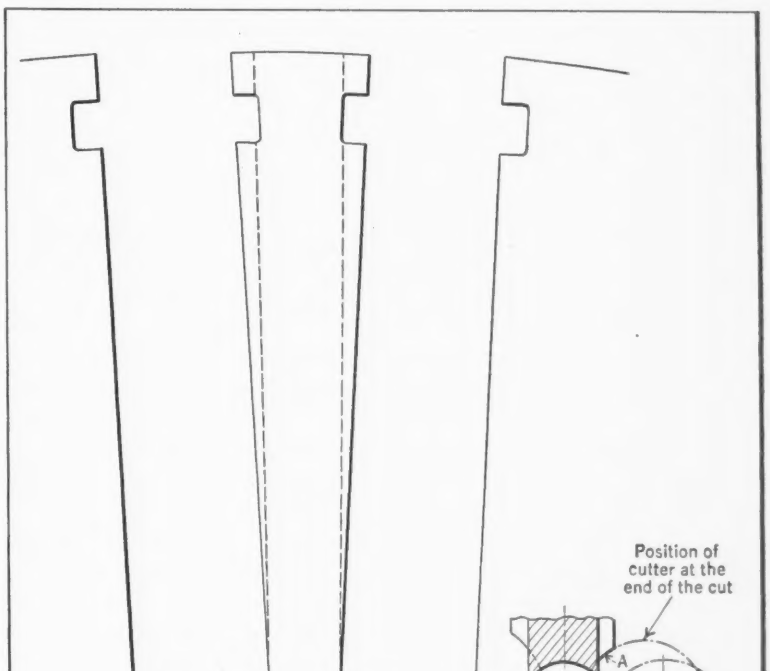



Fig. 3. Diagram of Work, Showing the Irregular Recess Cut by the Tool in Fig. 1

* * *

Perseverance and stamina reach the goal with greater certainty than the momentary flashes of brilliancy.

## Motor Drives to Reduce Idle Machine Time

The application of several motors to machine tools, each motor controlling some specific motion, has become increasingly important with present high cutting speeds. To take full advantage of the rapid cutting action, loading and unloading time must be reduced to a minimum. With a spindle that must be frequently stopped and started, or reversed, running at a relatively high speed, it is not feasible to make use of mechanical clutches; but a motor will do the work satisfactorily.

Rapid-traverse motors for moving heads or other parts into position promptly are also advantageous. They may or may not be combined with the feed motors. "In one recent milling machine design," says H. W. Harper of the General Electric Co., "the rapid-traverse motor moves the work at high speed toward the cutter. When close to the cutter, the feed motor takes up the load and moves the work past the cutter. On completion of the cut, the table is returned at high speed. These motions are taken care of in their proper sequence by control devices, and the non-productive time of the machine is cut down to a minimum."

# The Heat-Treatment of Broaches

**The Methods Described in this Article Represent the Practice of Leading Broach Manufacturers**

By WILLIAM E. SNOW

OF late years broach-making has developed largely into a specialty business, which manufacturers in general are content to leave in the hands of the half dozen concerns who make broaches for the trade. Yet a good many broaches are still made up in the tool-rooms of various machine shops—some from choice, others from necessity—for, owing to the wide variety of uses that broaches are put to, they cannot be standardized as to sizes, like taps and drills, and carried in stock.

As the great majority of broaches thus made up are of the simpler patterns, the making of which does not call for the special equipment to be found only in the shops of the broach manufacturers, the machining presents little difficulty, but the subsequent heat-treatment is a problem for the average hardening room.

Ordinary hardening methods do not produce satisfactory results in broaches and the broach-makers have developed special methods of their own. For this reason "homemade" broaches seldom produce as satisfactory results as the product of the broach manufacturer. For the benefit of those who are making their own broaches this article will outline the methods used in the hardening rooms of broach manufacturers.

Broaches can be hardened successfully in several ways, but the method here described seems to give the most general, all-around satisfaction, and it has the advantage of simplicity. While this method of hardening applies primarily to broaches, it can be used on other classes of tools where a combination of maximum strength and hardness is required.

### Selection of Steel for Broaches Should be Determined by Hardening Qualities

As most of the broaches used are of carbon steel—although high-speed steel now plays quite an important part—we will consider this material only. In making a broach, the selection of a proper steel is very important in view of the subsequent heat-treatment it has to undergo. The two prime requisites in a carbon broach steel are strength to resist breakage of the teeth in the pulling action, and hardness to resist wear of the teeth.

To resist wear properly, the edges of the teeth must show a Shore scleroscope hardness of not less than 84, while 87 to 89 is much better and is generally found in the broach-maker's product. A carbon steel of 1.15 carbon content, water-quenched, will give the required hardness, but it lacks the necessary strength and the teeth will break. A steel of 0.90 per cent carbon will have the necessary strength but, when water-quenched, will lack the required hardness. The broach-makers overcome this discrepancy by using a steel of approximately 1.00 per cent carbon, having the necessary strength, and double-quenching it, first in brine, and then in oil, to obtain the required hardness.

Select, therefore, the highest grade of straight carbon steel available, with a carbon content of 0.95 to 1.05 per cent—preferably 1.00 per cent—and be sure that it is thoroughly annealed, so that interlocking cooling strains cannot cause the broach to warp as metal is removed in machining. If an alloy steel is used for this purpose, the rapid cooling action of the brine quenching bath may cause excessive distortion.

### Care in Preparing Broach for Hardening is an Essential Factor

The shape of most broaches—thick bodies with thin teeth—necessitates slow heating to obtain even heat penetration throughout and thus avoid warping and cracking. As this causes excessive decarburization if a gas or oil furnace is used, it is necessary to pack the broach for protection. In the case of an electric furnace, where little or no decarburization occurs, this may be omitted, the broach being placed directly on the bottom of the furnace.

To reduce the chance of breakage of the broach at the point where it is held in the broaching machine, it is customary to leave the shank softer than the body and the teeth. This is especially necessary in the case of broaches which have a holding slot cut through the shank, with a consequent loss of strength at this point. As it is impossible to soften the shank after hardening without also drawing the temper of the teeth, this has to be taken care of in the process of quenching as follows:

Cut a sheet of asbestos to the length of the shank of the broach; wrap it tightly around the shank two or three turns, and tie it firmly in place with iron (stove) wire. Be sure that it covers the shank only and not any of the teeth. If the broach is of the type that has a slot in the shank, plug this slot with moist fireclay or asbestos wool before wrapping the shank. This asbestos covering, which is left on the shank of the broach during the heating and quenching processes, retards the action of the brine when the steel is quenched, leaving the shank much softer than the unprotected body of the broach and greatly increasing its strength. The broach is now ready for packing.

To pack the broach, place it in an iron pipe of suitable length and diameter, capped at one end

only. Fill in all around the broach with a half-and-half mixture of crushed charcoal and fresh burned bone—or any of the packing compounds sold for the purpose—tamping it down solidly to keep the broach from contact with the sides of the pipe. Plug the open end of the pipe with moist fireclay to keep the packing from burning out, and tie over it, with iron wire, a piece of asbestos to hold the clay in place. The broach is then ready for the furnace.

### Proper Hardening of the Broach Requires Correct Heating

The correct hardening heat for the broach will range from 1425 to 1450 degrees F., according to the actual carbon content of the steel used. It should be borne in mind that the brine quenching bath permits the use of a slightly lower temperature than plain water. The writer has found about 1435 degrees F. to be suitable on the average, but if in doubt about the matter, a few small, plain pieces of the steel used may be hardened first at varying temperatures, and broken. The piece showing the finest grain in the fracture will, of course, indicate the correct temperature.

Owing to the pipe and the packing surrounding the broach, the heat will penetrate very slowly, so that preheating is not necessary and the broach may be put directly into the hardening furnace. In the case of an electric furnace, where the broach is not packed, it should be preheated; if this is not done, cracks are almost certain to develop, with consequent loss of teeth.

Owing to the heat resistance of the packing, it takes much longer—three times as long at least—for the broach to take on the full heat of the furnace than in the case of steel not so packed. For this reason, the steel should be given plenty of time in the furnace for thorough heat penetration. Because of the action of the bone and charcoal, the steel is taking on carbon instead of losing it, so it can suffer no injury from "soaking" at full heat.

### Method of Quenching to Obtain Required Hardness and Strength

For quenching the broach, there is required, in addition to the usual oil tank to be found in all hardening rooms, a tank of brine. This brine may be made in the regular water tank, for temporary use, or an old barrel or similar receptacle may be pressed into service. The strength of the brine is not a critical matter; just stir in and dissolve coarse salt until it will float a potato, and it will serve the purpose.

When the broach is ready for quenching, remove the pipe from the furnace, knock out the clay plug, draw out the broach, and plunge it immediately into the brine quenching bath, being careful to immerse well and evenly all over. Under the rapid cooling action of the brine the steel will instantly set up a violent quivering or "kicking." This quivering, strong at first, but gradually subsiding as the steel cools, will continue for quite an appreciable time. When the quivering has nearly—but not quite—ceased, remove the steel from the brine and immerse it instantly in the oil, leaving it there until it is cool.

The strength and hardness of the broach can be varied to some extent by placing it in the oil when different amounts of quiver are perceptible. If the quiver is permitted to disappear entirely before removing the broach from the brine, the steel will be harder but more brittle. Removing it sooner leaves the steel stronger but less hard. A few trials, coupled with scleroscope readings, will readily determine the exact moment at which to remove the steel for best results.

In the brine quench it is advisable, in so far as the length of the broach and the size of the tank permit, to hold the steel in a horizontal position. This is readily accomplished by means of a couple of long-handled hooks for suspending the broach. Broaches, especially long ones, tend to warp more in cooling when dipped vertically than when immersed horizontally, and consequently entail more work in straightening afterward.

### Tempering is an Important Operation and Must be Correctly Performed

As soon as the broach has cooled sufficiently in the oil to permit of handling, it should be drawn. Do not let it get completely cold, and especially do not let it lie around with cooling strains locked in, as this is almost certain to result in cracked teeth, but remove it at once and draw.

The best tempering medium is, of course, an oil bath heated to the requisite temperature, but if this is not available, the drawing can be done in any furnace that is handy. This bath, or furnace, should be at full drawing temperature, of course, ready for the reception of the broach the moment it leaves the cooling tank of oil.

Draw at a temperature of from 380 to 400 degrees F., using the lower temperature for small broaches that are not used for severe work, and the higher one for large broaches subject to heavy duty and strains. Allow the broach to remain in the tempering furnace until it is evenly heated throughout its various irregular sections, then remove it and allow it to cool slowly in the air in a place free from drafts. Better still, turn off the heat and allow the broach to cool down slowly with the furnace. Do not on any account quench it after drawing.

### Testing Broach for Cracked Teeth

When the broach has cooled off, test for cracked teeth by rasping the teeth lightly along their backs with a short, light steel rod. If any are cracked, they will drop off under this treatment, in which case the broken surface can be ground down smooth and the broach can still be used if not too many teeth are gone. A certain amount of breakage of

the teeth in the making of broaches is to be expected. This is due to their shape, and not to improper hardening, in most cases. The broach manufacturers recognize this, and count upon a certain loss from this cause. They simply try to keep this loss at the minimum.

### Correct Procedure in Straightening Broach is Highly Important

Owing to the irregularity of section of most broaches, and the action of the brine quenching bath, considerable warping occurs during the hardening process, so that it is necessary to straighten the broaches before they can be used. Thin, flat shapes and small rounds are readily straightened by placing them on a surface plate and striking smartly with a light hammer, protecting the edges of the teeth where necessary by holding a piece of soft babbitt metal against them. Broaches of larger section, which are too stiff to yield readily to this treatment, are handled in a straightening press, as follows:

Place the broach on a surface plate and mark with chalk the spots to be straightened. Place it in the press with one of the spots to be straightened in position for bending, and heat that part only with a gas torch. Heat the steel slowly and uniformly by moving the torch to and fro during the process, exercising great care not to overheat it and thus draw the temper.

As the broach was tempered at 380 to 400 degrees F., the straightening heat should not be permitted to exceed 350 degrees F., for safety in this regard. To check up on this temperature, have on hand some short pieces of "fifty-fifty"—half tin, half lead—wire solder, which melts at slightly under 350 degrees F. Keep testing the temperature of the broach during the heating process by holding one of the pieces of solder against it. When the solder melts, the broach is ready to be straightened.

Apply pressure with the press until the broach is not only straight, but even bent slightly in the opposite direction, to allow for its tendency to spring back when the press is released. Then cool the broach quickly with cold water from a hose, to set it, before releasing from the press. Any other parts of the broach that require straightening may then be treated in the same manner.

On account of the rapid cooling action of the brine quenching bath, certain shapes of broaches, of very small section, sometimes warp unduly in heat-treatment, causing much difficulty in straightening. In these extreme cases, owing to the rapidity with which the small section of the broach can be cooled, a scleroscope hardness of at least 84 can generally be obtained, with less warping, by quenching in very cold plain water. This also applies to alloy steels, which have a still greater tendency to warp in a brine quenching bath, but which, owing to their deeper hardening properties, can be made to give a scleroscope hardness reading of 84 or better by quenching in water. This deep hardening property, however, has the drawback of reducing the strength of the teeth, which should have a soft, tough core with an extremely hard skin.

# Semi-Automatic Molding Process

A continuous molding machine used in the Cleveland Works of the Westinghouse Electric & Mfg. Co., makes it possible to produce 120 finished castings of quite large size in eight hours. The equipment consists of a continuous conveyor in the form of an oval, an automatic molding machine, a pneumatic vibrator, and conveyors and equipment for conditioning the sand.

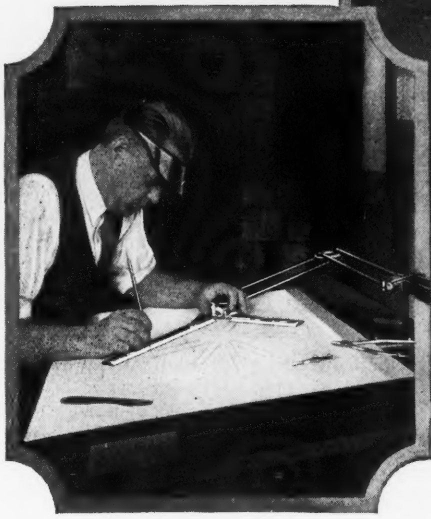
Twenty-five aluminum flasks travel through the molding and casting cycles on this continuous conveyor. These flasks are 28 inches wide, 43 inches long, and have a 6-inch cope and a 6-inch drag. They are employed for casting aluminum castings for street lights, cast-iron range frames and doors, and cast-iron bases for floor-model ironers.

The molding cycle is as follows: An empty flask is brought to the molding machine on the conveyor. The machine separates the cope and the drag, and inserts a match-plate pattern. The flask is closed, turned over, filled, and jolted. The bottom board is then clamped in place, and the flask again rolled over for filling and tamping the cope. Next, the match-plate pattern is removed, the flask closed, and the mold continues along the conveyor. All these operations are performed by the machine, their sequence only being directed by the operator.

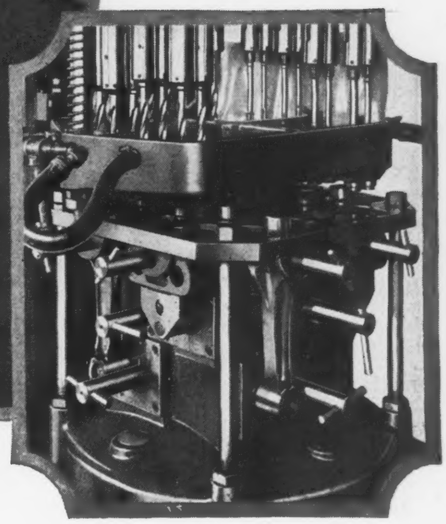
Two men pour the molds as they progress along their route. Having cooled sufficiently before arriving at the shake-out platform, a pneumatic vibrator shakes out the casting and removes the molding sand from the flask. The sand falls through a grate on a belt conveyor, and travels back to the conditioner for use again.

* * *

The Pennsylvania State College, State College, Pa., announces that the eighteenth annual Summer Management Course will be held at the College this year from June 7 to 15, inclusive. Current economic problems will be included among the topics for study. This course gives executives and other men in a supervising capacity an opportunity to exchange ideas with others occupied in similar positions, and affords them a chance to bring back many new ideas to their own plants.



# Design of Tools and Fixtures

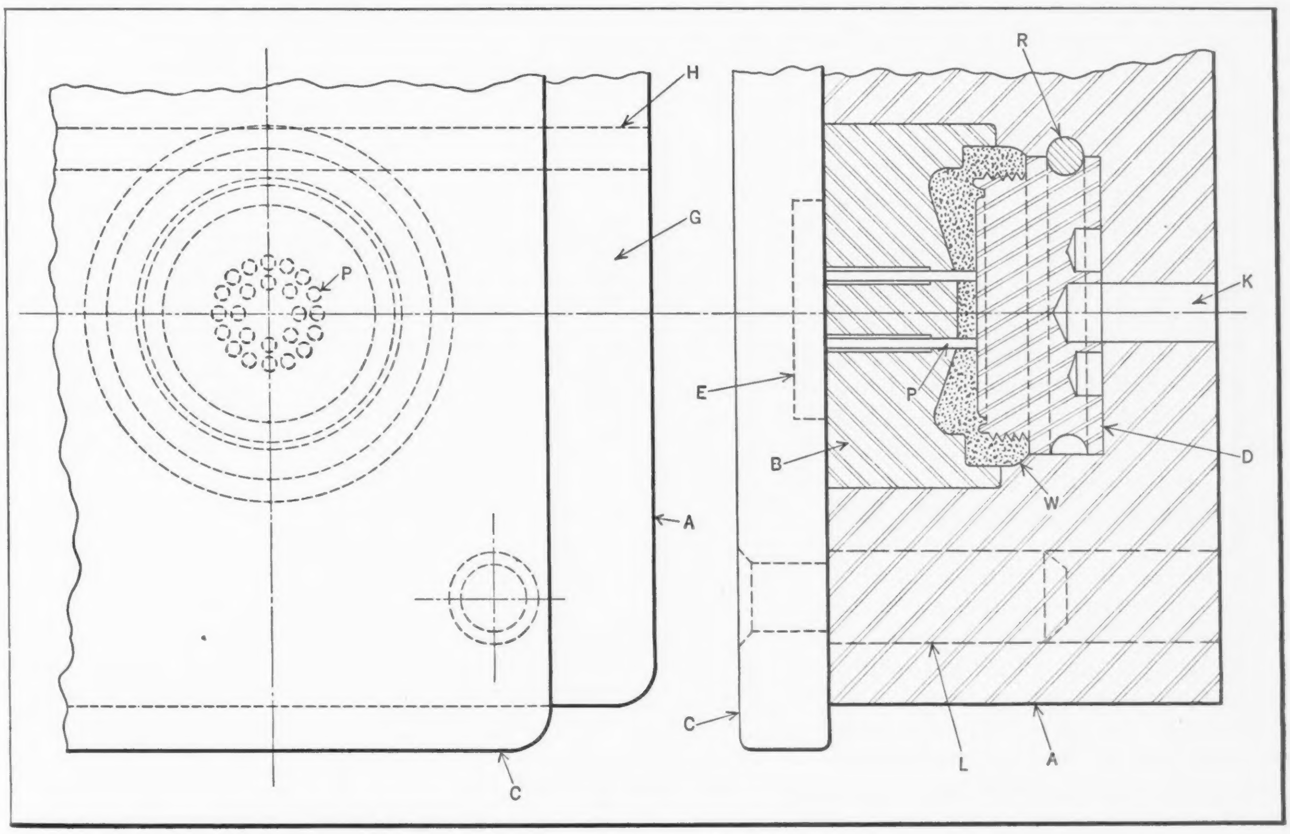


## Mold for Telephone-Receiver Caps

By C. W. HINMAN, Villa Park, Ill.

Telephone-receiver caps are molded from black Bakelite in a hand mold having four cavities, like the one shown in the accompanying illustration. The plan view to the left shows one corner of the mold; the three remaining corners are of the same design. The tool is designed to compensate for a shrinkage in the Bakelite of 0.0112 inch per inch. Cavity block *A* (sometimes called the "chase") contains the four molding cavities and is of sufficient size to provide a thick wall of metal between and around the cavities. This construction will safely withstand the necessary heat and hydraulic pressure applied by the press.

The four plungers *B* are attached to plunger-plate *C*, which is aligned by three easy fitting liner pins *L* riveted to plate *C*. The bases of the screw plugs *D* are a snug fit in the bottoms of the cavities. Four plates *E*, each having twenty-four pins *P* that pass through the plungers *B* and touch the faces of the screw plugs, are located in recesses in plate *C*.




Plan and Section Views of Cavity in a Four-cavity Die for Molding Bakelite Telephone-receiver Cap

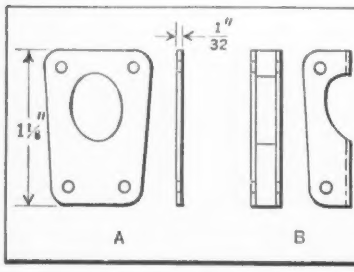



Fig. 1. U-shaped Clasp Blanked and Formed in the Die Shown in Figs. 2 and 3

Pins $P$ provide the cores that mold the required nest of holes around the center of the telephone-receiver cap $W$.

The screw plugs $D$ are held positively in place by two locking rods $R$ which slide through the width of the cavity block in hole $H$. These pins engage annular grooves in the screw plugs and prevent them from being lifted out when the plungers are removed. After the molding operation is completed, the tool is removed from the hot press and placed in the cold press to cool. Next, it is removed and turned top face down on two parallel bars on an arbor press. The outer edges or surfaces $G$ of the cavity block $A$ rest on the two properly spaced bars.

The guide pins $L$ on plate $C$ are next ejected by means of a knock-out plate (not shown) which has three pins spaced to make contact with the ends of pins $L$. The work, of course, remains on the screw plugs. The two locking rods are next removed and the screw plugs, with the work attached, ejected into a tray by means of another pin plate (not shown). The pins in this plate enter the centrally located knock-out holes $K$ in the cavity block. The mold is then reloaded, using other screw plugs, and replaced in the hot press. The previously finished work is unscrewed from the plugs $D$ with a special wrench that engages the three holes at the back of the plugs.

The preceding description applies only when using the equipment as a hand mold. When the output is increased, it is planned to attach the mold members to the upper and lower hot press platens, so that the press action will open the tool and eject the work semi-automatically.

An important feature in all plastic molding tools in which the plunger face comes in contact with the bottom of the cavity, as it does in this case, is to have such contact occur when the inside of the plunger-plate is within 0.005 to 0.007 inch of the face of the cavity block. That is, the plunger face must make contact with the bottom of the cavity in advance of the contact between the plunger-plate and the cavity block. This insures a positive contact under the pressure exerted by the press, accurately determines the height of the piece, and prevents the formation of fins around the bottom of the work.

Hardened and highly polished tool-steel molds are necessary in order to withstand the high molding pressures and heat employed for work of this kind. In the case of the mold described, all the working parts are made from Deward tool steel having a Rockwell hardness of 51 to 53. These parts are all hardened and polished, drawn to 450 degrees F., and chromium-plated. All the ejector-plates are of tool steel, but are not hardened. The ejector-pins are made from drill-rod stock, not hardened.

## Combination Blanking and Forming Die for U-Shaped Clasps

By VINCENT WAITKUS, Consulting Mechanical Engineer
Baltimore, Md.

An order was received by a manufacturer for one million hinge clasps like that shown at $B$ in Fig. 1. Only a single-action press was available for the work; hence some ingenuity was required in designing the die to obtain the required production at a satisfactory cost. The die that resulted is shown in Fig. 2. It is of the three-station, progressive type, using an automatic strip feed. No operation is performed at the second station, as this station was added merely to facilitate the construction of the die. At the first station, all the holes are pierced, and at the last station, the part is blanked to the

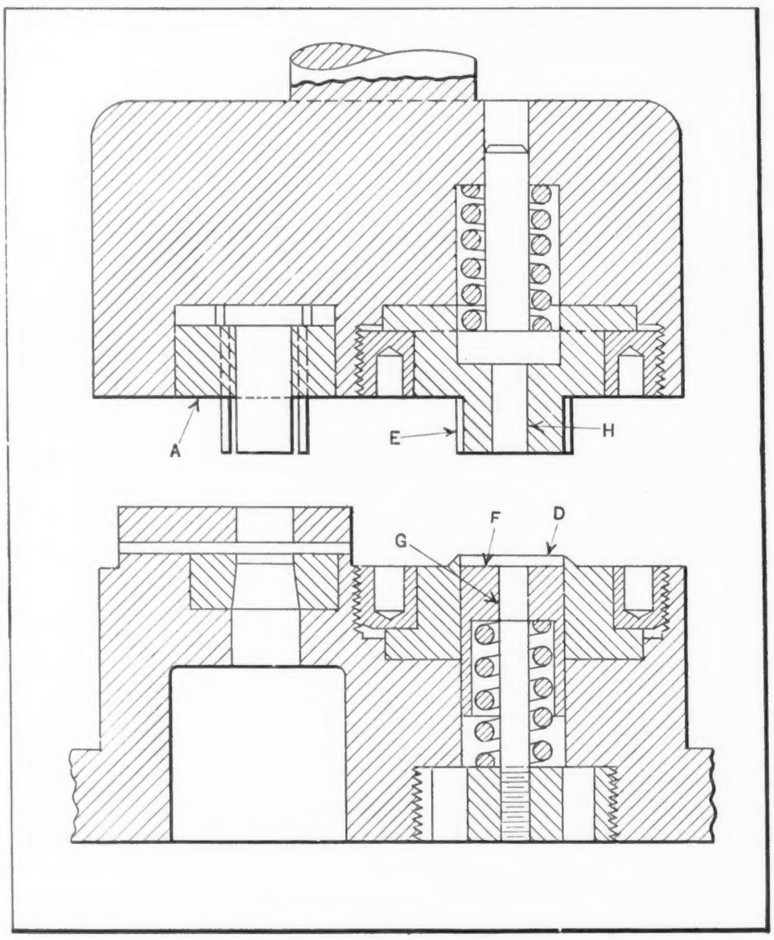



Fig. 2. Progressive Die for Clasp Shown in Fig. 1, in which the Blanking and Forming are done at One Station

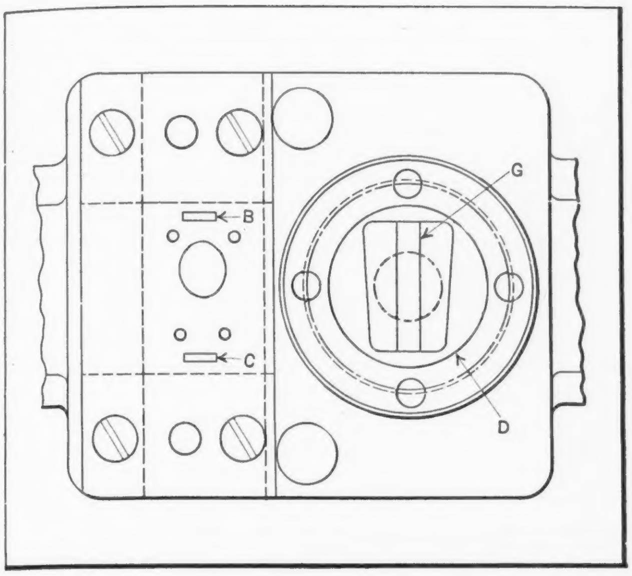



Fig. 3. Plan View of Die Shown in Fig. 2

shape shown at *A*, Fig. 1, and formed to the shape shown at *B*.

All the piercing punches are secured in the punch-block by the clamping plate *A*, Fig. 2. Besides the five holes in the blank, two rectangular holes are punched in the strip at *B* and *C* (see plan view of die, Fig. 3) at this station. The cutting edges at the corresponding points of the blanking die are removed to make room for a slot for the forming punch.

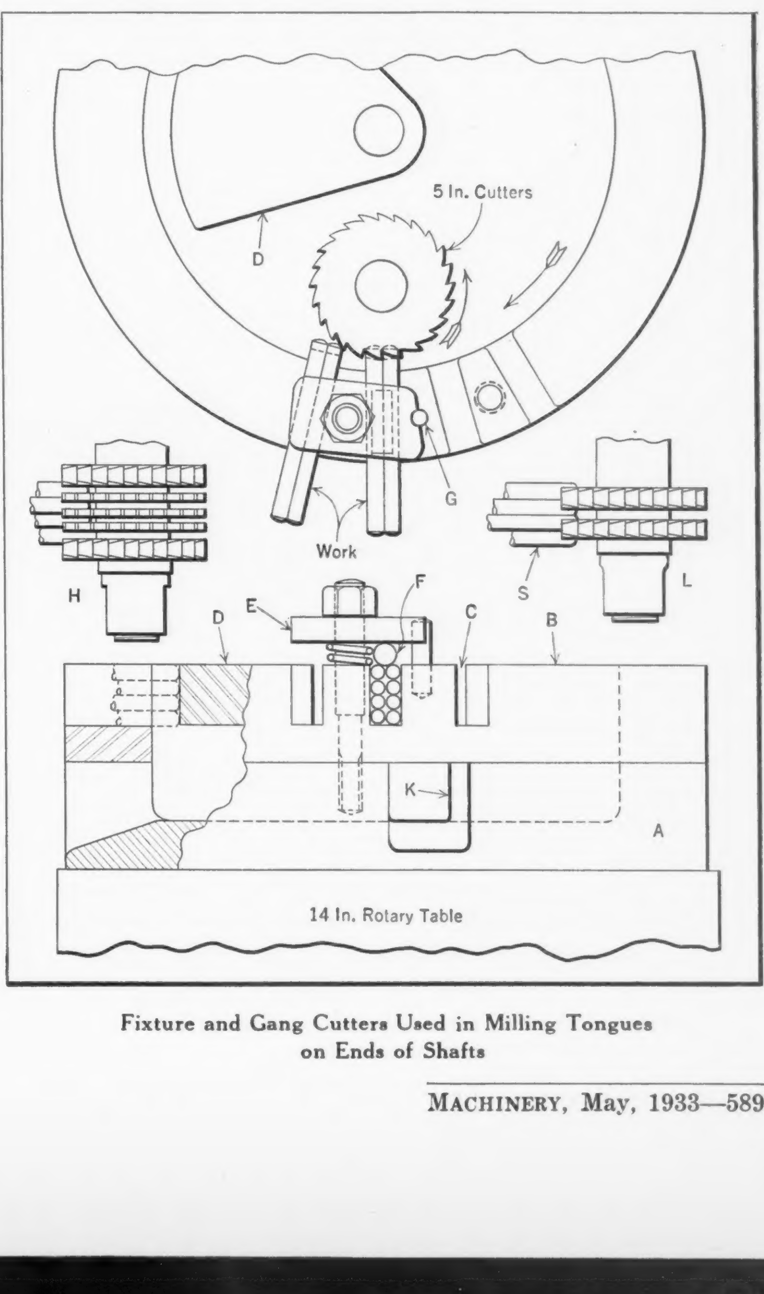
At the last station, the pierced section of the strip is centralized over the blanking punch *D*, Fig. 2. As the ram descends, the part is blanked by the punch *E* and deposited on the spring pad *F*. As the punch, blank, and spring pad continue to descend, the blank is formed to a U-shape over the stationary punch *G* secured in a spanner nut. The ram now ascends and the part is stripped from the forming punch *G* by the spring pad *F*. When this pad has assumed its normal position, the continued upward movement of the ram will cause the stripper *H* to eject the part from the blanking punch *E*. As the press used is of the inclined type, the part readily slides from the die into a container on the floor.

## Rotary Fixture for Milling Tongues on Shafts

The illustration shows a high-production milling fixture of the rotary type for cutting tongues on the ends of shafts. The combination of multiple loading and gang cutting gives an output of 1500 pieces per hour. The fixture consists of a base *A* attached to the rotary table, and a ring *B* which has twenty-four work-holding slots in it. Each of these slots accommodates eight shafts. The shafts are loaded into the slots at the front of the fixture opposite the stationary gage *D* by pushing them against the gage and tightening the clamps *E* while the fixture is rotating.

Each clamp serves to hold the shafts in two slots. Clamping pressure is obtained through the hardened pin *F*, which fits between the two top shafts and the clamp. This pin is used to insure uniform clamping of both rows of shafts. The pin *G* prevents the clamp from turning while being tightened or loosened.

The gang of cutters used for milling is shown at *H*. Three of the cutters are of the metal-slitting type, whereas the upper and lower cutters are of the side-milling type and are somewhat wider, since they cut on one side only. The base of the fixture is provided with eight openings, as shown at *K*, to facilitate the removal of chips. By changing ring *B*, different sizes of shafts can be accommodated. The cutter set-up shown at *L* can be substituted for the one shown at *H* for milling the shafts as indicated at *S*. This fixture can also be used for slotting the ends of rods or shafts. Such work, of course, requires a gang cutter having properly spaced cutters of the right thickness. W. F. C.



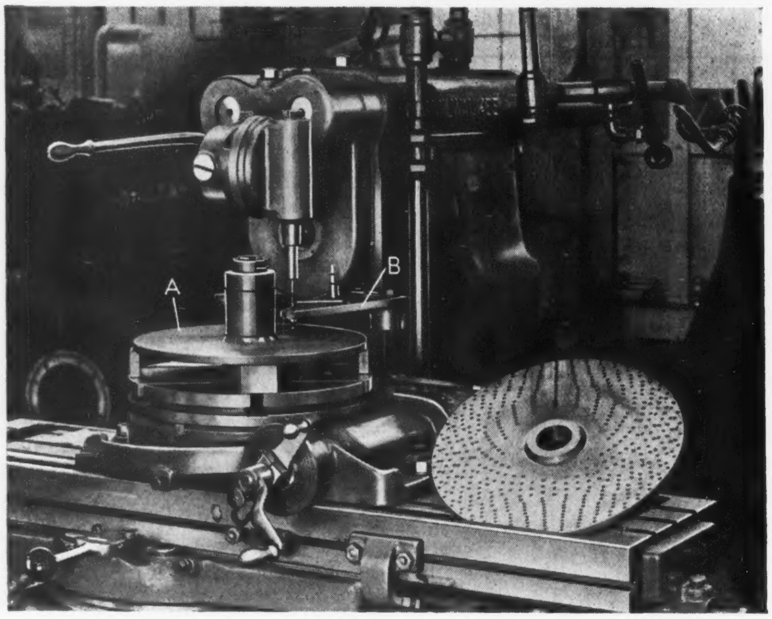

Fixture and Gang Cutters Used in Milling Tongues on Ends of Shafts

## Laying out Accurately Spaced Holes

By FRANK W. CURTIS, Research Engineer
Kearney & Trecker Corporation, Milwaukee, Wis.

A set-up for drilling accurately spaced holes in index-plates for jigs and fixtures, as well as for drilling small drill jigs, is shown in the illustration. It consists of a rotary index-table and a small high-speed universal head which are used on a knee-type milling machine. The operation shown is that of drilling and reaming a pair of special index-plates, requiring several hundred holes. The work-piece *A* rests on four hardened parallel blocks, and is located over a plug from which it is clamped to the rotary table. On the column of the machine is fastened the drill-bushing plate *B* which is used to guide the drill or reamer. In using this set-up, drilling is done by engaging the vertical feed to the knee of the machine.

In handling work not requiring radially spaced holes, it is possible to use the cross-feed to the saddle and the longitudinal feed to the table, making the adjustments by hand. Likewise, the set-up can be used for jobs requiring a combination of circular- and straight-spaced holes. If the machine is in good condition, the holes can be spaced very accurately.



Milling Machine Set-up for Laying out and Drilling Accurately Spaced Holes

The bushing plate is bolted to a bracket which is fastened to the column of the machine over the dovetail slide. This plate is provided with a master bushing so that slip bushings for drilling and reaming can be used. The plate may be removed from the bracket and interchanged with other plates for drilling different sized holes.

* * *

## Data on Small and Medium-Sized Plants

The American Machinery and Tools Institute is gathering data on small and medium-sized manufacturing establishments, and for this purpose is distributing a questionnaire to firms willing to cooperate. The questionnaire can be obtained by addressing the Institute at 40 N. Wells St., Chicago, Ill. A composite report will be sent to those firms who furnish information.

## History Repeats Itself

A report made to the Senate of the State of Pennsylvania in 1820 was recently quoted by J. S. Tritle, vice-president and general manager of the Westinghouse Electric & Mfg. Co. This report read in part: "There has been a general suspension of labor, the only legitimate source of wealth, in our cities and towns, by which thousands of our most useful citizens are rendered destitute of the means of support, and are reduced to the extremity of poverty and despair... an almost cessation of the usual circulation of commodities and a subsequent stagnation of business, which is limited to the mere purchase and sale of the necessities of life..."

Commenting on this statement, Mr. Tritle said: "Certainly the troubles of that day could not be blamed on mechanization, because it had not yet begun. Yet the country was relatively in worse distress than today, and even a greater percentage were unemployed. However, the nation recovered in due time from this distress, and since that time there have been other trying periods, but always there has been recovery. In nearly every one of these depressions the cry has been raised that the growth in the use of machines has been one of the prime causes of the trouble."

Shall we ever begin to realize that depressions are due to economic causes and not to engineering developments, and that these economic causes are susceptible to control by human agencies just the same as machines are susceptible to engineering control?

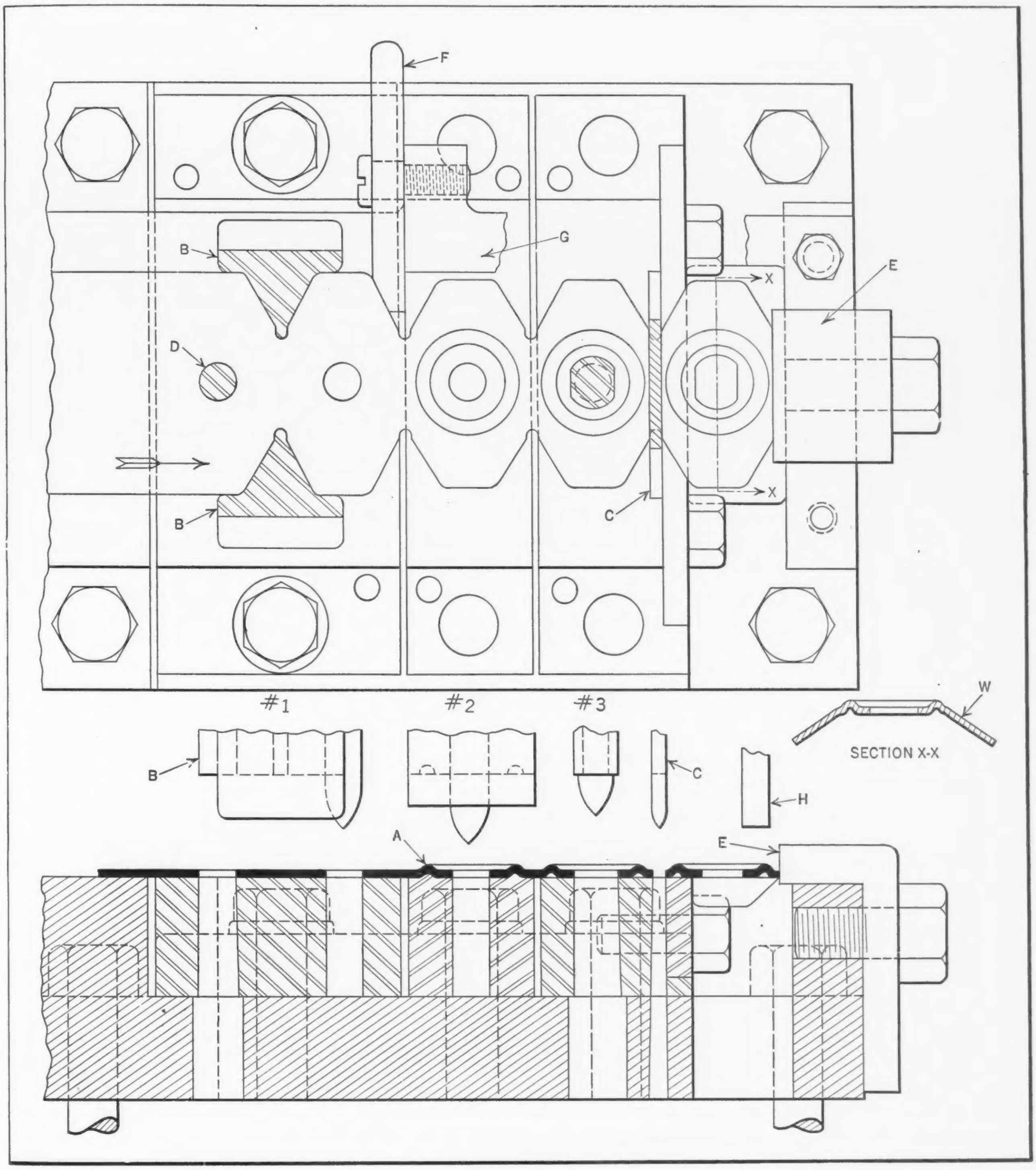
* * *

It is of interest to note that the taxes—federal, state, and municipal—imposed upon the motor-vehicle user exceeded by some 40 per cent the total wholesale value of the cars and trucks manufactured in 1932. The total motor-vehicle-user taxes amounted to $1,085,000,000, while the value of the output of automobile factories was only$784,000,000. One-third of the cost of gasoline is now collected in taxes by federal and state authorities. Motor-user taxes account for 12 per cent of the federal, state, and local taxes from all sources.

# Follow-Die for Producing Valve-Stem Washers

By C. S. SCHWAEBLE

As all automobile tire tubes must have a valve-stem and a formed bridge-type washer, it is obvious that great quantities of these parts are required. The formed washers, one of which is shown at *W* in the accompanying illustration, are made in several sizes. They are produced from coiled hot-rolled sheet steel, 0.060 to 0.070 inch thick and of the exact width required to produce the pieces without clipping the sides. This permits narrower stock to be used than would be the case if dies of the usual blanking type were employed, and results in a considerable saving in material.




Follow-die Used with Push Type Roll Feed for Producing Formed Washer W

The stamping of the raised ring at *A* and the bending down of the sides requires a fairly heavy blow. On this account, the punches are placed in the exact center of the press, in line with the center of the crank. This tends to eliminate any heavy side thrust on the ways or guides of the press and allows the machine to be operated at maximum speeds with less danger of the bearing surfaces becoming overheated or cut. The side-clipping punches *B* and the parting punch *C* are made wider than the strip stock, with the sides extending downward below the cutting edges. This allows the extended portions of the punches to enter the dies and to be lined up accurately before any actual cutting is done. Such construction practically eliminates all danger of the punches being sheared in the dies, and also facilitates the setting up of the die.

A pillar type power press with a "push" roll feed is particularly well suited for dies of the kind illustrated. This die is made up of three sets of individual dies and punches bolted to the main die- and punch-blocks. The clipping punches *B* and a preliminary round piercing punch *D* come into operation at the first die position, the stock being fed from left to right. The preliminary piercing of the round hole allows the metal to "pull" or be drawn away from the center when stamping the ring-shaped bead in the following operation.

The side-clipping punches give the washer the required shape or outline, and leave a connecting strip in the center by which the stock is pushed along to the finishing or parting position at the end of the die. The punch and die at the third position re-pierce the central hole, increasing its size and producing two flat sides. This allows the washer to fit freely over the valve-stem with which it is to be assembled. The parting die at *C* clips out the connecting strip between the pieces. The stop shown at *E* is used when it is desired to cut all the pieces to a uniform length within close limits. While extreme accuracy is not essential for work of this kind, correct spacing will make the line cut by the parting tool blend nicely into the radius-formed corners of the work.

When a roll feed is required to pull the strip stock from a heavy coil, the feed is often uneven and must be compensated for by the drawing action of a pilot. If the slippage is too great, the pilots are likely to be bent. The tools may also be broken if the press is not stopped promptly. Such occurrences, of course, cause delays for repairs which, in due time, must be checked up against the cost of tool upkeep.

If the rolls are overfed, the strip of metal will bump against the stop *E* and slippage will occur after the strip is in position, giving the pilots sufficient time to enter before the rolls are lifted. It is not necessary, however, to lift the rolls with this type of stop unless the metal has a tendency to crawl sidewise, so that it becomes cramped in the guides, in which case it is better to lift the rolls for a new grip at each feeding movement.

The standard type of stop-finger *F*, shown attached to the stripper at *G*, may be used also. By lifting the rolls when the end of the strip is reached, and disengaging the feed pawl, the strip can be pulled up to the stop *E* after each stroke, so that the entire strip can be used up. The die in the third position extends but one-fourth of the length of the piece past the edge of the cutting-off die. This allows the work to overbalance after being cut off and fall down through the die into a box which is separate from the scrap-box.

Dies of the type shown, when run in a short-stroke press, are often operated at 150 to 200 strokes per minute. At such speeds the work will not fall fast enough to prevent clogging, and a spring pin *H* is placed in the punch to snap the work over the edge of the die the instant it is cut off, so that it will be out of the way of the stock when it is advanced for the next operation.

Several machines equipped with dies like the one illustrated can be run by one man, provided that the individual punches and die-blocks are accurately lined up and properly doweled; that the roll feeds are set to allow the right amount of slippage; and that an automatic stop is provided for stopping the press when the end of the strip stock is within about 6 inches of the feed-rolls.

* * *

## Conference on Re-Engineering for Economical Manufacture

A conference on Re-Engineering for Economical Manufacture will be held at the Case School of Applied Science, Cleveland, Ohio, May 10 to 12. Among the papers to be read are the following: "Planning for Profits," by J. M. Carmody, management consultant, New York City; "Production Development," by E. L. Shaner, editor of *Steel*, Cleveland, Ohio; "Re-Design of the Products to Increase the Appeal to the Purchaser," by R. E. Hellmund, chief electrical engineer, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; "Development in Manufacturing Processes," by D. Levinger, engineer of manufacturing, Western Electric Co., New York City; "Selection of Equipment," by H. P. Bailey, assistant to the president, Warner & Swasey Co., Cleveland, Ohio; "Metal Forming to Eliminate Machining," by Charles D. Harmon, National Machinery Co., Tiffin, Ohio; "The Place of Stampings in the Product," by J. K. Olsen, chief draftsman, Stewart-Warner Corporation, Chicago, Ill.; "Influence of Welding on Design and Production," by R. E. Kinkead, consulting engineer, Cleveland, Ohio; "Manufacturing Quantities for the Small Industry," by J. C. Wattleworth, factory manager, Vlchek Tool Co., Cleveland, Ohio; and "Operation Study," by R. M. Blakelock, General Electric Co., Schenectady, N. Y. Further information pertaining to the meeting can be obtained from Professor E. S. Ault, Case School of Applied Science, Cleveland, Ohio.

# The Shop Executive and His Problems

**Superintendents and Foremen are Invited to Exchange Ideas on Problems of Shop Management and Employe Relations**

IN January MACHINERY, C. H. Hays calls attention to an important subject—the standardization of sizes of sheets for manufacturing data. I agree with Mr. Hays, because my experience shows that it is a waste of money and effort for manufacturers to circulate, in the industry, valuable information printed on sheets so large that they are either consigned to the waste basket or folded up and put into the drawer of a desk. Some sheets, again, are too small to fit into a standard ring binder, and are equally difficult to keep for permanent reference.

Would it not be possible for manufacturers to get together and determine upon a standard size of sheet, fitting standard-size ring binders? The circulation of these sheets is good advertising, and they ought to be of such a size that they can be kept constantly before the men to whom they are sent. CHARLES R. WHITEHOUSE

## This Factory Library Pays Dividends

Most factory libraries, unfortunately, serve as an office ornament rather than as a source of information. Many industrial managers do not fully recognize the value of technical books and magazines, in spite of the fact that their success in manufacturing depends upon the use of the latest in manufacturing equipment and methods.

The Q & R Mfg. Co., located in the East, is an exception. This company reaps handsome profits from its investment in a library which has a modest collection of the latest technical books and which subscribes to a number of technical journals, applying both to industrial management and to subjects more closely allied to the company's products.

The president of the company is the mainspring of the library idea, his slogan being, "We have a book for everybody, and everybody must read his book." The president sees to it that this idea is carried out. Every year the department heads are required to submit reports on new books pertaining to the work of their departments. This means that they have to obtain and scan all worthwhile technical book catalogues. Furthermore, they ask to have such books as appear to contain new information sent on approval. These books are examined carefully; and those that seem to warrant being included in the library are recommended for purchase. The aggregate book bill is governed by the annual budget.

The younger executives and shop foremen are required, periodically, to take books and magazines from the library for "home work," and to submit written reports with comments on the subject matter. This policy, coupled with monthly and quarterly monetary awards for the best report submitted, has caused the library idea to be taken seriously by every member of the organization. The careful reading of technical books and magazines thus enforced has solved many difficult problems, introduced short-cuts in methods, and led to innovations in policies; above all, it has helped to keep everybody alert and thinking. The management is satisfied that its library investment in money and time is bringing more than the customary returns.

JAMES J. BAULE

## Four Stages in the Design and Application of Mechanical Devices

In the building and using of tools or machines, there are four successive steps or stages encountered—design, construction, use, and upkeep. The manner in which the first three of these stages are handled determines to a great degree the conditions surrounding each subsequent stage.

The design affects the cost of construction, the utility of the tool or machine, as well as the cost of upkeep and repairs. The construction affects the use as well as the upkeep. The manner of using the machine also has an effect upon the upkeep. This indicates the inter-relation of the four stages.

In a sense, design is the most important step, because all the following stages depend upon it. The fundamental principles in any design are relatively few, compared with the details involved.

In developing a design, it is well to remember that there are but two possible movements of the members in any mechanism—circular and reciprocating. Since each of these motions can produce the other, and both are interdependent, there is, in reality, but one composite motion. The designer's problem is, therefore, according to his experience and ability, to adapt these two simple motions to his needs.

A designing problem involves, strictly, but two factors: First, to know exactly what the mechanism must accomplish; and, second, to supply the necessary operating movements by the practical application of these two mechanical motions—circular and reciprocating. C. W. HINMAN

# MATERIALS OF INDUSTRY

*The Development, Properties and Application of Materials Used in the Mechanical Industries*

## Suggestions for Molding Synthetic Plastic Materials

By C. W. HINMAN

THE process of molding plastic materials must be carried out under well defined conditions in order to give the best results. Like most other mechanical processes it is subject to troubles that affect the quality of the product or the production rate. Difficulty is sometimes experienced in locating or correcting some of these troubles. For this reason, the following notes from a partial record of service engineering experiences during the last five years will be of assistance to those interested in or connected with the production of molded parts from materials such as Bakelite and Durez.

1. *How to Avoid Low Strength and Poor Finish Caused by "Precuring"*—The premature hardening of a portion of a mold charge to the point where it is no longer plastic under heat is usually called "precuring." Precuring results in molded parts of low strength and poor finish. It is caused by allowing the charge to stand in the mold for several minutes before being placed in the press. To avoid precuring, the mold should be put in the press as quickly as possible after loading. The average mold should be closed within fifteen to thirty seconds from the time it is placed between the platens of the press.

2. *Lack of Strength May be Due to Under-Curing*—A molded tool handle was found to be breaking in service. Examination showed that the resinoid material was under-cured. Moreover, considerable material had escaped from the flash mold instead of being compressed into the finished handle. The shape of the preformed tablet was changed and the time of cure increased to six minutes. The tablets were pre-warmed, and the mold was closed more slowly to prevent the escape of material. A handle, thus made, could be pounded on the floor until the metal part was seriously deformed without damaging the handle.

3. *Arranging Equipment for More Convenient Operation Increases Production 45 Per Cent*—A molder who was producing jar covers was obtaining a production of but 130 pieces a day. A stop-watch study of loading and curing time, made by a service engineer, revealed that it was taking 7 1/2 minutes for each cycle. The press platen was too high, and the arbor press was too far from the molding press, making efficient handling out of the question. A platform was built in front of the presses and the distance between the arbor press and the molding press was reduced. This resulted in raising the production to 190 covers a day—a gain of 45 per cent.

4. *Preventing Gas Pockets and Surface Blisters*—In molding phenol-resinoid materials, gases are given off under the heat and pressure of the molding operation. If a ready escape is not provided for these gases, the molded piece is likely to have interior gas pockets and surface blisters. This trouble can be overcome readily by the practice known to the trade as "breathing the mold"—that is, releasing the pressure for a period of three or four seconds after the mold is first closed. Pre-heating the molding tablets for ten or fifteen minutes at a temperature of 180 to

***The production manager is confronted with two major problems — the selection of materials from which to make a product and the equipment with which to make it. This new section "Materials of Industry" will deal with the development, properties, and application of materials used in the mechanical field, forming an important addition to "Shop Equipment News" which has always been a feature of MACHINERY'S service.***

190 degrees F. will also be found a very effective means for checking the tendency to blister.

An "air-bound" mold is another fruitful cause of blistering. Such a mold is one in which the top force fits into the chase so snugly that there is no means of escape for the heated air or gases given off in molding. This occurs only in positive molds of the "straight-draw" type. To avoid air binding, the mold force should be made with a free sliding fit in the chase and should be provided with sprue grooves to allow for the escape of gases.

*5. "Puffing" Reduces Curing Time*—In 1926, a company producing 5000 tube bases a day was using the following cycle: (a) Loading and discharging, 1 minute 20 seconds; (b) closing mold, 40 seconds; (c) curing, 2 minutes. A service engineer demonstrated that the two-minute cure could be reduced to 1 1/4 minutes by "puffing." Thus, they included in their operation a slight opening or release of the mold about ten seconds after the first closing, and standardized on a cure period of 1 1/2 minutes. In 1930, the cure required less than one minute.

*6. Precautions to Take when a Small Mold is Used in a Large Press*—Whenever possible, the practice of using a small mold in a large press should be avoided. The excessive pressure applied on the small surface of the mold may drive the mold into the platen of the press and score it badly. When it is absolutely necessary to use a large press with a small mold, it is a wise precaution to place auxiliary steel blocks at the sides of the mold. These blocks should be approximately the same height as the mold.

*7. Detecting and Eliminating Defects Due to Faulty Heating*—In one instance of alleged shrinkage, in which the finished piece was under size, it was found that the gas-heated presses were operated at too high a temperature. The alleged shrinkage was really warpage, and it affected the shape of a central slot that was required to be accurate in size and shape. In this case the use of shrink plugs eliminated the trouble.

The use of hard water will cause coating of the steam channels in the mold, and this, by interfering with the thermal conductivity of the metal, will influence the curing and chilling effect. Such changes will cause surface defects on the molded piece.

In molding a typewriter space bar, a poor surface finish was found to be due to insufficient curing. This was caused by poor heat conduction, which, in turn, was caused by warpage of the mold, which permitted a thin film of resinoid material to become located between the bed plate and the mold and thus act as a heat insulator. This trouble was eliminated by machining and relocating the mold to give a good contact surface.

In molding a coil cap, a void was formed in the center of the molded section. The material was not flowing properly into place because the force of the mold having long pins in it was allowed to rest near an open window for several minutes during the loading operation. Consequently, it became so cool that the flow of material was retarded. The trouble was corrected by keeping both the top and the bottom mold parts hot. Proper molding was facilitated by heating preformed disks for one hour at 210 degrees F.

A large three-cavity, positive mold for the production of parts with a thin, deep wall section required a "soft" material with quick-flowing properties. In operating this mold, sticking occurred in the middle cavity. On checking with a pyrometer, it was found that after a period of forty-five minutes under steam, the end cavities registered 300 to 325 degrees F., while the center cavity registered 250 to 270 degrees F. As these molds were operated with a chill, the production temperatures would be still lower. This indicates the importance of having the molds so designed as to maintain the same temperature in all cavities.

A fast curing molding material was found to take an unusually long time to cure. Investigations showed that the drum of material was shipped and stored during a blizzard. When the material was put in the mold, a long time was required to heat it through. As the material was a good heat insulating medium, it was naturally slow in reaching room temperature before molding.

*8. Molds and Material Must be Free from Impurities*—It is good practice to use an air hose to clean off the mold between cycles. Care must be taken, however, not to blow impurities into the supply of molding material, nor dirt or foreign matter into recesses in the mold. It is sometimes found that the pump supplying the air pressure has its intake located near the floor, where it picks up dust and dirt. In such cases, an air filter should be included in the air-supply line used for cleaning the dies.

Large silver-gray spots, appearing without apparent cause on the surface of molded parts, were attributed to oil or water having gotten through the air hose.

In the molding of an electrical instrument case, blistering occurred, but only on one side of the part. The material was blamed. A service engineer found that a small amount of snow was drifting through a ventilator in the roof and settling in the open cavities of the tilt-head press mold. When the ventilator was closed, the blistering trouble disappeared entirely.

*9. Individual Shrink Plugs Correct Variations in Cavities*—On a twelve-cavity mold for a cylindrical automobile part, four cavities were left empty because of broken pins. Operators were equipped with five sets of shrink plugs for each cavity, and they stated that on taking from a given cavity five successive parts, differences in size after shrinking on the plugs until cold were between 0.003 and 0.007 inch. The mold cavities differed slightly—hence the different sets of marked shrink plugs. In spite of the indication marks, the operator was not

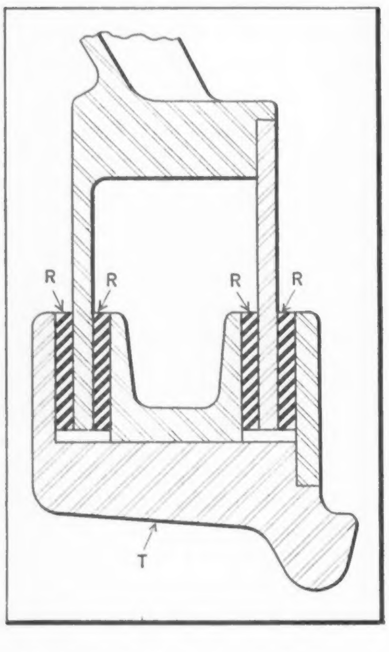
taking any particular care to put the part from a given cavity on the right plug. Proper use of the shrink plugs removed all trouble.

Misaligned mold pins are always a source of trouble and frequently cause the cracking or breaking of the molded part.

*10. Careless Cleaning of Mold Cavities Destroys Finish*—The manufacturer of an electrical device requiring exact dimensions and high polish complained of steel particles in one of the drums of molding material. It was found that a workman had been using a steel screwdriver to clean the mold cavities. Three cavities in the mold had been badly scored by this treatment and the cavities required repolishing.

## Cushioning Railroad Car Wheels with Rubber

New developments in the application of rubber in machine construction, including a variety of rubber mountings used to absorb vibration in a wide range of products, were described and illustrated in April, 1932, MACHINERY. Now the application of rubber cushioning to the wheels of rail coaches to obtain quiet running seems to have been successfully accomplished. This new development was described in a recent paper by C. W. Bedford, tire development engineer of the B. F. Goodrich Rubber Co., Akron, Ohio. The construction of this rubber cushioning, as shown in the accompanying illustration, is a development of this company and the engineers of the Clark Equipment Co., Battle Creek, Mich., who now use it on the wheels of the Clark "Auto Tram."




Method of Mounting Rail Coach Tire T on Wheel with Rubber Cushions R

Although efforts to use rubber cushioning on railroad wheel equipment date back over fifty years, earlier designs seem to have been failures. With the design illustrated, the multiple soft-rubber inserts *R*, adjacent to the outer rim *T*, are installed in a preloaded condition and carry the load, as well as the friction braking stress, entirely by shear distortion. The rubber inserts are so positioned that all the rubber carries its full share of the load at all times. That is, the rubber in the upper half of the wheel supports as much load as the rubber in the lower half. Under a shear loading of 10 pounds per square inch, a wheel of the construction illustrated, which is now in use, will easily support a load of 4200 pounds per wheel. Wheels constructed in the manner described can be easily designed to carry loads up to 12,000 pounds per square inch and even higher.

## Heat-Resisting Nickel-Chromium Alloy Castings

The ability of nickel-chromium alloy castings to stand up under high temperatures is well illustrated by an example cited by Ralf S. Cochran of the Surface Combustion Corporation in a paper presented before the American Society for Steel Treating. Beams containing 25 per cent chromium, 19 per cent nickel, 0.35 per cent carbon, and 3 per cent silicon, used in 5-foot spans, did not sag over 1/8 inch in two years of service at 1400 to 1600 degrees F. At higher temperatures (1750 to 1850 degrees F.), the beams held within a 1-inch sag under similar conditions.

## Selecting Pipe Material to Obtain Satisfactory Threaded Joints

**By William Anderson**

In the selection of pipe, the threading characteristics are not always given due consideration. Success in threading pipe depends to a great extent on the material from which the pipe is made. In the manufacture of pipe, the principal metals used are wrought iron and steel. When purchasing iron pipe, wrought iron should be specified as, otherwise, genuine wrought-iron pipe may not be secured. Of the steel used for pipe, there are two principal classes, depending upon the process of manufacture, namely, open-hearth and Bessemer. Each of these steels possesses different working properties and characteristics.

Using threading equipment such as is used in some jobbing shops, open-hearth steel is very difficult to thread properly. Bessemer steel will thread more readily, and is preferable when steel is required. Genuine wrought-iron pipe can also be threaded without difficulty.

A simple test can be made on pipe bought from supply houses to insure that the specified metal is obtained. This consists of filing and cleaning a bright spot on the pipe and applying nitric acid. The acid will leave a dark spot on steel; the darker the spot, the harder the steel and the more difficult it is to thread. Genuine wrought-iron pipe remains bright when touched with the acid. Leaky joints due to poor threads can often be prevented by applying this test to determine the machineability of the metal.

## Process for Stabilizing Stainless Steel

The development of a method of stabilization of 18-8 (18 per cent chromium, 8 per cent nickel) stainless steels by the addition of titanium has been announced by the Subsidiary Companies of the United States Steel Corporation, 208 S. LaSalle St., Chicago, Ill. This important development removes the hazard of intergranular corrosion, a phenomenon that has heretofore been a serious factor in installations where heat-treatment is impracticable after welding and in cases where these steels are used in applications involving high temperatures. The process and methods of heat-treatment used in the production of stabilized 18-8 stainless steel are covered by patent applications now pending. This product will be marketed as USS Stabilized 18-8 stainless steel.

## Nickel Alloys for Resisting Corrosion

Nickel-bearing alloys have proved themselves exceptionally well suited to resist corrosion in equipment used in the handling and manufacture of condensed and evaporated milk, according to a paper recently read before the Division of Agricultural and Food Chemistry of the American Chemical Society. Pure nickel, Monel metal, and nickel-chromium stainless steel are all well suited for the purpose mentioned.

## Coloral—A Process for Oxidizing and Coloring Aluminum

A process for oxidizing and coloring aluminum and its alloys is being introduced on the market by the United States Research Corporation, 40-35 Twenty-first St., Long Island City, under the trade name of "Coloral." By this process, an oxidized finish can be obtained that is practically immune to atmospheric corrosion or a high luster finish can be secured in any color or color combination. While the process has just been made generally available, it has been in commercial use for approximately three years, and so is past the experimental stage. The details of the process were worked out by the technical staff of the concern, which is headed by Colin G. Fink and L. C. Pan.

Coloral is a two-stage process, the first stage being an electro-chemical oxidizing treatment which produces a hard non-tarnishing, non-corrodible, non-porous finish that can also be used as a base for any other finish. The second stage is simply an immersion in the coloring bath, which penetrates the hardened oxidized surface and gives it a fast permanent color. If a protective coating only is wanted, the treatment terminates with the oxidizing step.

The company's interest lies solely in the sale of the electrolyte for the bath and the material for coloring, no royalty or engineering fee being charged for the use of the process. The process can be applied to aluminum sand and die castings as well as to aluminum sheets.

## "Cerro-Base"—A New Low Melting Point Alloy

An alloy known by the trade name "Cerro-base" has been placed on the market by the Cerro de Pasco Copper Corporation, 44 Wall St., New York City. This alloy has a number of unusual characteristics—it has a melting point of only 123.5 degrees C.; it is non-shrinking; it is fairly malleable and fairly ductile, and has approximately three times the tensile strength of pure lead. It consists of 58 per cent of bismuth and 42 per cent of lead.

One of the principal uses for "Cerro-base" at the present time is in attaching glass and porcelain to metals, the alloy forming a coupling or bushing which connects the two materials. The design of the parts to be assembled is of much importance in the success of this application of "Cerro-base."

## Machined and Centered Phosphor-Bronze Bars

Cored and solid bars of phosphor-bronze bearing metal, machined on the outside and on the ends to eliminate a large part of the work heretofore necessary in making bushings, bearings, etc., have been placed on the market by the Bunting Brass & Bronze Co., Toledo, Ohio. The solid bars are also centered on the ends.

Bars 13 inches long instead of the conventional 12-inch lengths can be furnished. The longer bars permit the cutting of bushings in multiples of 1 1/2, 2, 3, 4, and 6 inches. One of the advantages claimed for the new bars is that all hard surface scale has been removed, thereby eliminating cutting difficulties. It is also stated that the outside diameters of the cored bars are closely concentric with the inside diameters.

## Nichrome V—An Improved Heating Material

A new series of Nichrome nickel-chromium alloys to be known as "Nichrome V" has been brought out by the Driver-Harris Co., Harrison, N. J., to meet the demands of heat-treating departments for a heating material that will have longer life under high temperatures and quick heating conditions. These materials can be used as the heating element for the following electric furnaces: Heat-treating, carburizing, annealing, nitriding, enameling, bright-annealing and others. In tests, this alloy has exceeded the expectations of the engineers who developed it, and it is anticipated that the results in service will be wholly satisfactory. More than twenty-five years have passed since the first of the Nichrome series was developed by this company.

# One-Hundredth Anniversary of the Brown & Sharpe Mfg. Co.

ONE hundred years ago, on April 22, 1833, the advertisement reproduced on this page appeared in the *Providence Daily Journal*. It announced the establishment of the business that is now known the world over as the Brown & Sharpe Mfg. Co. The hundred years that have passed since David Brown and his son, Joseph R. Brown, established the partnership D. Brown & Son at 43 S. Main St., Providence, R. I., broadly cover the era of the development of the mechanical industries in the United States. In this development, machine tools—the master tools of industry—have been one of the essential factors, because the machine that builds machines, after all, is the cornerstone of our mechanical age.

D. BROWN & SON—WATCH, CLOCK MAKERS. &c.; have taken the Stand No. 43 South Main street, Sign of the Turret Clock, where they offer their services in the above business.

They will give occular demonstration that they are prepared, and by assiduity will show themselves qualified, to supply many of the wants of others to their satisfaction.

They will pay particular attention to repairing Watches and all other Time Pieces that may be offered, and make such as are called for. They have for sale, 1 Turret Clock, and 1 large Cutting Engine, on an improved plan.

They have a Dividing Engine for making the most accurate graduations for Mathematical and Nautical Instruments, and will attend to making and repairing such as are ordered. They intend to exhibit specimens of their own production, for sale.

Dividing Plates for all sized Engines graduated in the most perfect manner.

Spur, Spiral and Bevel Geer, and Screws for Worm Geer. Tops, &c. for repairs of Spinning Machinery, turned and cut as directed.

Various Jobs will be punctually attended to.

After having been to great research and expense, and arrived to do the above work with despatch by manual labor only and individually, they think they need only to be known to have steady business.

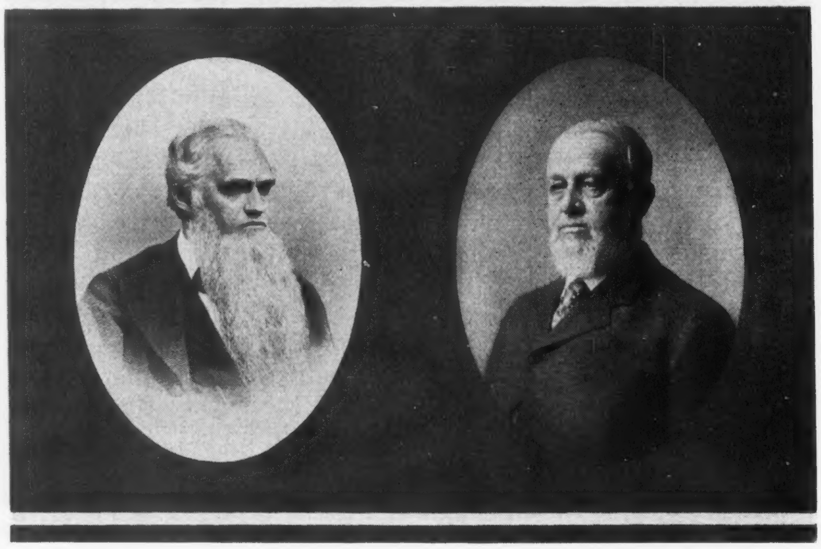
DAVID BROWN.
JOSEPH R. BROWN.

N. B. A Tenement wanted, suitable for six in a family; with no small children. a22 MT3w

The First Advertisement of the Business that was to Become the Brown & Sharpe Mfg. Co., as it Appeared in the Providence Daily Journal, April 22, 1833

The steps by which the business founded one hundred years ago, which has been successively known as D. Brown & Son, J. R. Brown & Sharpe, and the Brown & Sharpe Mfg. Co., has aided in the mechanical evolution were, first, in the manufacture and repair of clocks and watches, including some notable tower clocks which are still dependable timekeepers; second, in the making of accurate scales, micrometers, and other measuring tools; third, in the manufacture of equipment for the making of sewing machines and in the building of sewing machines; fourth, in providing machines and tools for the manufacture of firearms during and after the Civil War; fifth, in the developing of equipment for typewriters, cash registers, and all types of calculating and recording machines; sixth, in the manufacture of equipment for bicycles; seventh, in the manufacture of machinery for automobiles; and, eighth, in meeting the needs for the manufacture of airplanes, radios, and the endless lines of other modern developments.

The history of the Brown & Sharpe business may be traced briefly as follows: During the earlier period of the partnership of David Brown and his son, Joseph R. Brown, some of the most important work done consisted in building tower clocks. These clocks attained a high reputation. In 1850, steps



Joseph R. Brown, Who with His Father, David Brown, Founded the Firm of D. Brown & Son in 1833

Lucian Sharpe, Who Served an Apprenticeship with Joseph R. Brown and Who Became a Partner in 1853

were taken by Joseph R. Brown to branch out in pioneer work to raise the standard of accuracy in machine shop operations. In that year, he built an automatic linear dividing engine, which, as far as is known, was the first machine of this type used in America. He then entered upon the manufacture of standard rules for machinists. The next year he brought out the vernier caliper reading to one-thousandth inch. This was followed a few years later by the micrometer caliper.

Lucian Sharpe, who had served an apprenticeship with Joseph R. Brown, became his partner in 1853. Mr. Sharpe's executive and business ability had a decided effect upon the expansion of the business from that time on. Agencies were established and the products of the company were widely advertised. Mr. Sharpe had a large share in the development of the screw and wire gages that have ever since been regular products of the company.

In 1866, Samuel Darling of Bangor, Me., who also manufactured steel rules, formed a partnership with Messrs. Brown and Sharpe, and in 1868, moved his plant to Providence, this part of the business being conducted under the name of Darling, Brown & Sharpe, while the main business was incorporated the same year under the firm name of J. R. Brown & Sharpe. The two businesses were consolidated in 1892 under the present name, the Brown & Sharpe Mfg. Co.

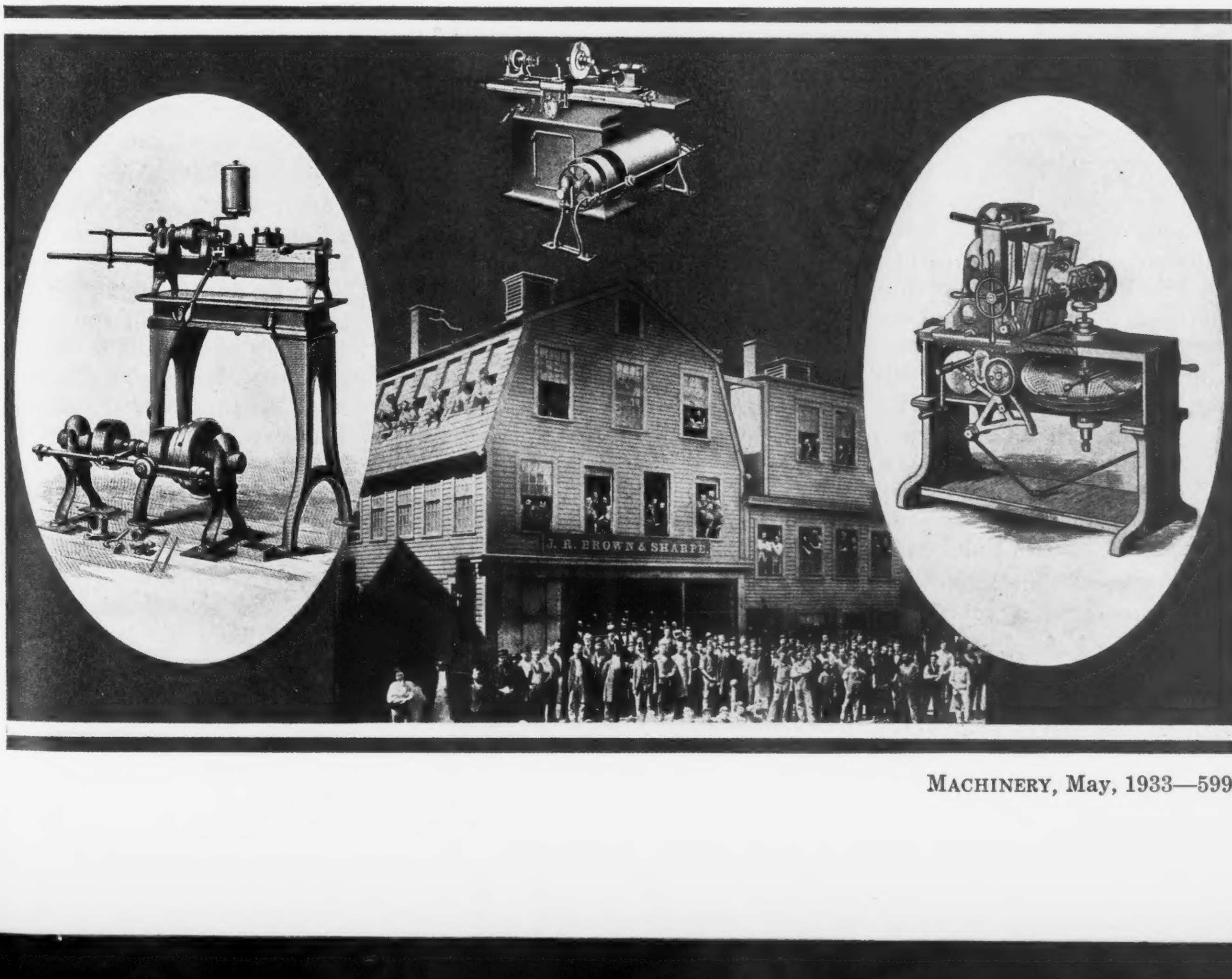
The demand for arms during the Civil War led to a great expansion of the business and to many inventions. Among the most important of these was the development of the universal milling machine by Mr. Brown in 1861 and 1862. A line of manufacturing milling machines was also brought out at this time for producing interchangeable parts in large quantities. Closely connected with the invention of the milling machine was that of the formed cutter, an important step in the production of accurate cut gears.

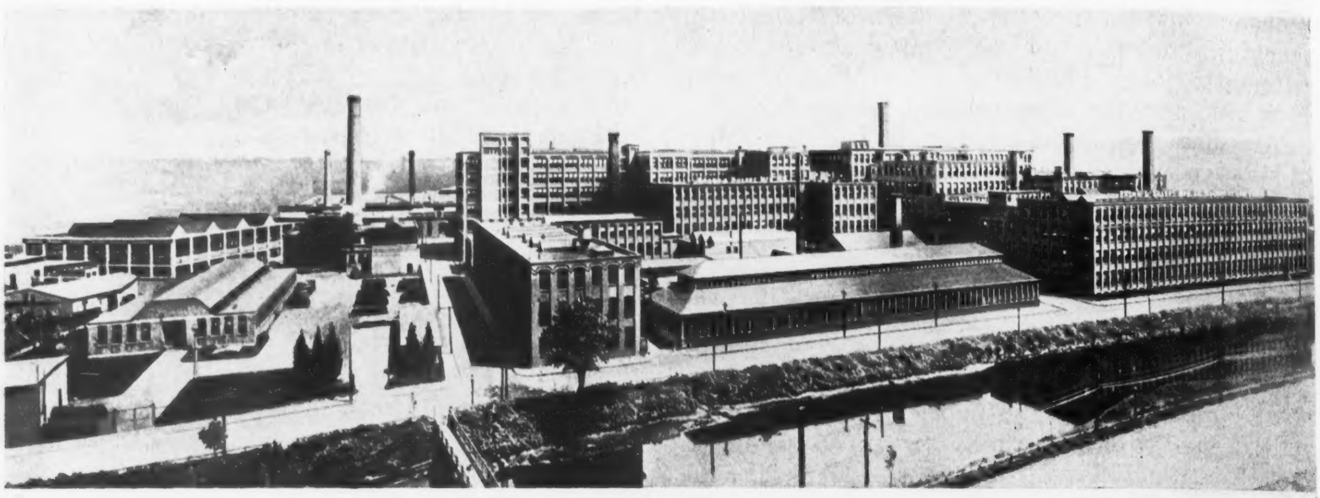
As early as 1855, J. R. Brown & Sharpe had built a precision gear-cutting machine. In connection with their interest in the cutting of accurate gears, they took an important part in establishing the standard system of interchangeable involute gearing which has since become universally adopted. In 1861, turret screw machines began to be built, followed later by the fully automatic screw machine.

The universal grinding machine, another of Mr. Brown's inventions, was evolved from crude beginnings for the purpose of grinding hardened sewing machine parts. It was developed into the full-universal grinding machine completed by Mr. Brown shortly before his death in 1876. Automatic gear-cutting machines were brought out in 1877, and more recently, were followed by a line of gear-hobbing machines. Another of the important fields of endeavor with which the name of Brown & Sharpe is associated is the making of standards of measurement and measuring machines.

In the early days, the business was carried on in a wooden building not especially adapted

The Old Works of J. R. Brown & Sharpe in 1872, Just Before Removal to the Present Location of the Plant of the Brown & Sharpe Mfg. Co., and Some of the Pioneer Machine Tools Built—a Screw Machine of 1865, a Grinding Machine of 1875, and a Gear-cutting Machine of 1855





The Present Works of the Brown & Sharpe Mfg. Co. at Providence, R. I., Covering a Floor Space of Over Thirty-two Acres

to the work. In 1872, a new fireproof factory was erected at a location about half a mile from the business center of Providence. The growth has since been around this original building until now the ten main manufacturing buildings have a floor space of about 900,000 square feet, with a foundry covering 245,000 square feet, and forging, hardening, power plant, and miscellaneous buildings covering about 264,000 square feet. The total floor space of the present buildings is over thirty-two acres.

The Brown & Sharpe Mfg. Co. has played an important part in another direction in the American manufacturing industries. Since the very beginning of the business, it has maintained a well organized apprenticeship system. Hundreds of Brown & Sharpe apprentices have gone to every part of the world after completing their courses, adding to the number of inventors and manufacturers of mechanical products. Many have achieved not only well merited success in their work, but have become figures of national importance in manufacturing, prominent among these being the late Henry W. Leland, long identified with the Cadillac motor car and later president of the Lincoln Motor Car Co.

# Machine Tool Builders' Association Holds Spring Meeting

The thirty-first spring convention of the National Machine Tool Builders' Association was held at the Hotel Cleveland, Cleveland, Ohio, Monday and Tuesday, April 24 and 25. Questions of importance to the industry at the present time were discussed, and a number of papers dealing with current problems were read. E. P. Blanchard, of the Bullard Co., spoke on "Financing Machine Tool Sales"; Dean Dexter S. Kimball, of Cornell University, spoke on "A Philosophy for the Machine Tool Builder for the Next Ten Years."

"Our Foreign Trade and the Tariff Question" was dealt with by P. E. Bliss, of the Warner & Swasey Co., while H. S. Robinson, of the Cincinnati Shaper Co., spoke on "What Can Industry Do to Improve Methods of Government Buying?" Other subjects discussed at the meeting were the question of guaranteeing production in the user's plant and the extent to which machines should be placed in the customer's shop on trial. At the dinner held Monday evening, William E. Wickenden, president of the Case School of Applied Science, was the chief speaker.

© Bachrach

Edward A. Muller, New President of the Machine Tool Builders' Association. Mr. Muller is President of the King Machine Tool Co. of Cincinnati

# Selecting New Equipment to Produce Net Profits

**An Analysis of the Methods by which Financial Returns from New and Improved Shop Equipment Can be Accurately Predetermined**

By H. P. BAILEY, Assistant to the President
The Warner & Swasey Co., Cleveland, Ohio

THE problems of selecting industrial equipment have changed considerably during the last four years. In the 1928 and 1929 period, attention was centered chiefly on the problem of increasing production to meet the demands of the sales department. Today, quantity production has vanished for most of us, and our major equipment problem is to cut the cost per piece in the face of diminished volume of production. The demand of the management is to cut 1929 costs, regardless of low shop activity, and the difficulties of this problem challenge the best thought of production executives.

Moreover, the management is now anxious to conserve cash in the face of the uncertainties of the business situation. As the factory executive turns to the purchase of new equipment to aid in solving his problems, he meets a serious financial resistance on the part of his treasurer and chief executive. He must justify his request for new equipment in positive terms, for today, in most cases, the chief executive controls equipment buying directly and definitely.

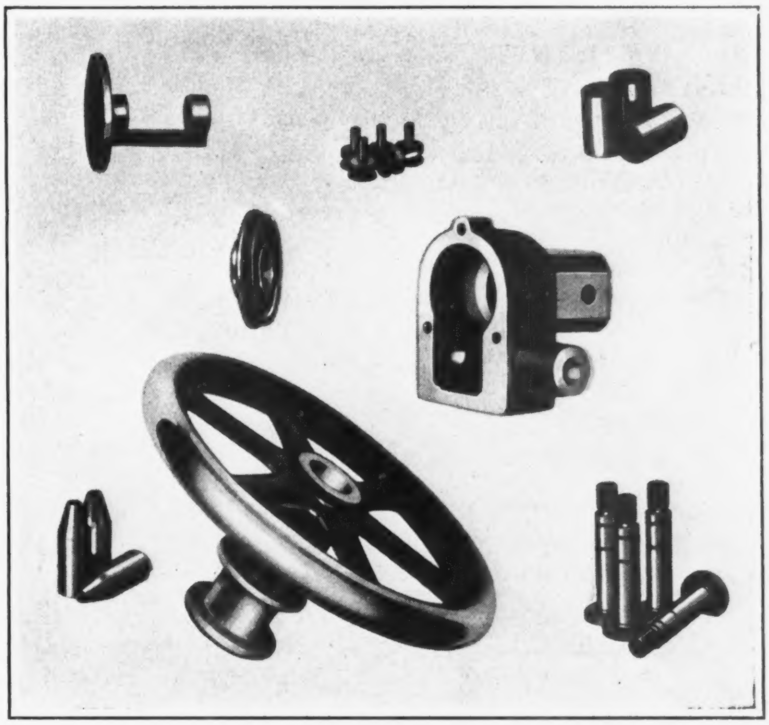


Fig. 1. Examples of Work to be Produced in Comparatively Small Quantities

These new factors in the problem of the factory executive—the low rate of production, the cash situation, and the control of equipment buying by the chief executive—make it imperative that the factory executive consider the selection of new equipment not only from the production viewpoint, but also from the point of view of the chief executive. If the factory executive is to succeed in getting the new equipment that he requires to cut costs, he must justify the expenditure to the chief executive by facts and figures. He must demonstrate the ultimate net profits that will arise from the purchase of equipment under existing conditions. His buying method today should meet three requirements:

1. The buying method should face the facts of diminished volume of production, and estimate the savings from new equipment on the basis of the activity that exists now and in the near future.

2. The buying method should evaluate the savings expected from the new equipment in dollars and cents, and should visualize the opportunity for net profits that will arise from the purchase of equipment to reduce costs.

3. The buying method should present in summary form the answer to two questions: First, that of the factory executive, "How long will it take for the equipment to pay for itself?" and second, that of the chief executive, "What percentage of net profits will the investment return?" This is the language of the chief executive and the treasurer, and is the only basis on which they will release cash for investment in fixed assets under present conditions.

The buying method suggested in this article for the purchase of industrial equipment was developed by the Warner & Swasey Co. some years ago, and all purchases of equipment for that company's plant have been based on this method. A typical illustration will make clear its application to present conditions and will show how the factory executive analyzed his problem and then persuaded the management to approve the purchase.

The basic problem of the shop superintendent consists in cutting the cost per piece of a variety of work, such as shown in Fig. 1, produced in relatively small quantities. The parts shown are of cast iron, steel, aluminum, and bronze, and the quantities per lot vary from 25 to 800 pieces.

The first step in the buying method is to determine the average time savings that may be expected, due to using the proper method of machining. This was done by analyzing the typical jobs that were selected by the production manager, and computing the savings as shown in the table "Time Saved on Eight Typical Operations by the Installation of New Equipment." The first column in the table shows the present actual time. The second column shows the time with the new equipment. The third column shows the actual number of minutes saved for each piece. All figures include the set-up time, or the period necessary to prepare the machine for operation. The time figures are based on a 48-minute hour to allow for the inevitable delays in shop operations. The note below the table gives the average time per piece by the present method and by the improved method. The result shows that the present average time is 26.7 minutes, and the time with the new equipment 18.5 minutes per piece.

With these production facts as the basis, the equipment replacement statement is prepared, as shown in Fig. 2. In this statement the savings per average piece are first evaluated, in terms of dollars and cents; then the production per month possible with the new equipment is computed, after which the savings per piece are multiplied by the maximum possible production to give the maximum gross savings per month. From this is deducted 20 per cent for idle time, as estimated by the production manager on the basis of the higher production of the new machine. It will be noticed that the statement answers the question of the factory executive, "How long will it take for the machine to pay for itself?", and the final conclusion answers the question of the chief executive, "What will be the percentage of net profits from the investment?" This meets the three requirements of our buying method for today's condition, and the factory executive has not only ascertained the facts, but has also prepared them in a form that is suitable for presentation to the chief executive.

**Warner & Swasey Equipment Replacement Statement**

Average former cost, 26.7 minutes (per piece) x 2½¢ . . . $ .667
(with direct labor at 60¢ and overhead at 90¢, a total of $1.50 per hour, or 2½¢ per minute)

Average cost with new equipment 18.5 min. (per piece) x 2½¢ .463

Savings per piece . . . . . . . . . . . . . .204

Production per month with new equipment:

60 min. (per hr.) x 9 hrs. (per day) x 23 (working days) / 18.5 minutes per piece (with new equipment) = 671 pieces

Total savings per month will then be:

671 (pieces per month) x .204 (savings per piece) . . . $ 136 88

If the new equipment is kept busy only 80 % of the time, deduct 20 % for idle time . . . . . . . . . .

20 % of 136.88 (Savings per month) . . . . . 27.37

Value of usable savings per month . . . . . . . . 109 51

Investment in new equipment . . . . . . $ 2 690 00

Less resale value of old equipment . . . . 300 00

Net cash investment in new equipment . 2 390 00

**The new equipment will pay for itself in:**

$2,390.00 (Net cash investment) / $ 109.51 (Usable savings per month) = 21.9 months

**The Net Profit return per year will be:**

$109.51 (Usable savings per month) x 12 months . . . $ 1 314 12

Less 20% depreciation on $2390.00 (Net cash investment) . . 478 00

Net Profit per year after depreciation . . . . . . . . . 836 12

**The rate of Net Profit will be:**

$ 836.12 (The Net Profit) / $2,390.00 (Net cash investment) = 35.0 %

Fig. 2. An Equipment Replacement Statement, as Prepared for a Typical Case

During the actual process of selecting industrial equipment, our organization obtains considerable help from the sellers. Our fundamental problem is actually the same as that of the seller; namely, to select equipment that will bring the highest possible return on the investment under the conditions. Since the salesman is seeking a profit through the sale of his equipment, we consider it proper to ask him to share at least a part of the burden of analyzing the entire situation.

The production engineer, therefore, asks the seller to suggest, in detail, equipment that, in the light of his experience and knowledge, will produce the best net-profit return on the investment. Then the equipment supervisor checks the time estimate and asks proof in support of the seller's estimate of speeds, feeds, handling time, etc. If this proof is not forthcoming, the time will be modified to suit the conditions. Fundamentally, however, it is a real advantage to work with the seller—first to find the facts, and then to increase the net-profit return on the investment in three ways, as follows:

1. By endeavoring to develop methods that will increase the percentage of time saving per piece through the careful application of various machines and tools to the problem of the shop.

### Time Saved on Eight Typical Operations by the Installation of New Equipment

| Machining Time, in Minutes, when Using Present Equipment | Machining Time, in Minutes, when Using New Equipment | Time Saved per Piece by Using New Equipment, Minutes |
|---|---|---|
| 22 | 16 | 6 |
| 20 | 14 | 6 |
| 60 | 40 | 20 |
| 45 | 30 | 15 |
| 9.8 | 8 | 1.8 |
| 14.5 | 11.2 | 3.3 |
| 14.6 | 10.3 | 4.3 |
| 27.5 | 18.3 | 9.2 |

According to this table, the average machining time per piece with the present equipment is 26.7 minutes, and with the new equipment 18.5 minutes, giving an average saving in time per piece of 8.2 minutes when the new equipment is used.

2. By seeking to find as much work as possible that can be done at a saving on the new machine, so that as high a proportion as possible of the maximum potential saving of full-time operation of the equipment can be obtained.

3. By trying to select types of equipment that will reduce the cash investment as far as possible, in order to increase the percentage of net profits. If the investment can be reduced, the deduction for depreciation will be lowered, and the divisor of the net-profit equation will be smaller, thus increasing the net-profit percentage.

Successful cooperation along these three lines will increase the net-profit percentage much more than was assumed in the initial steps of this buying method. If the percentage of time saving can be increased, the net-profit percentage will increase still more rapidly. If the rate of activity is increased, the realizable profits will be enlarged, while the deduction for depreciation will remain constant. If the investment can be cut, the net-profit percentage will increase much more than in direct proportion. Let us examine these phases of the situation more closely.

#### Increasing the Time Saving

For example, let us take the equipment replacement statement shown and see the exact results of different percentages of time saving. In Fig. 3 the vertical axis shows the percentage of time saving; the horizontal axis, the annual net-profit return on an investment of $2390. In the case of the original illustration, the percentage of time saving is slightly over 30 per cent, and the chart shows a net-profit percentage of 35 per cent. If the time saving could be increased to 40 per cent, the net-profit return would be about 55 per cent.

On the other hand, if the analysis of the situation had been incomplete and had resulted in a time saving of only 20 per cent, the net-profit return would have dropped to 14 per cent. Our gross savings would have dropped and our production per month would have dropped, while our depreciation deduction remained constant. With a return of only 14 per cent, our factory executive would have had a relatively weak case, since the chief executive usually feels that a net-profit return of 20 per cent is necessary to justify investment under existing conditions.

The exact effect of variations in the facts behind the net-profit statement on the net-profit return cannot be guessed; one cannot jump at conclusions. The net-profit statement contains a number of interacting variables, such as the percentage of time saving, the rate of activity, the amount of investment, etc. Only actual computation of the net-profit statement, which takes about five minutes once the facts are known, will show the net-profit percentage in a given case.

#### Increasing the Rate of Activity

The term "rate of activity" means the proportion of full-time machine activity. For example, if we expect to keep the machine operating three-fourths of the time, the rate of activity will be 75 per cent.

Under present circumstances, the wisdom of purchasing equipment often depends on the rate of activity. The net-profit return may be quite satisfactory in a given case when the activity is from 80 to 100 per cent, while in the same case the return may be unsatisfactory if the activity is only from 40 to 50 per cent. The effect of different rates of activity may be seen by referring to Fig. 4.

The vertical line again shows the percentage of time savings, while the horizontal line shows the annual net-profit return for an investment of $2390. The center curve for 80 per cent activity is the same as shown in Fig. 3. The curve to the left shows the net-profit return with a 60 per cent rate of activity, while the curve to the right gives the re-

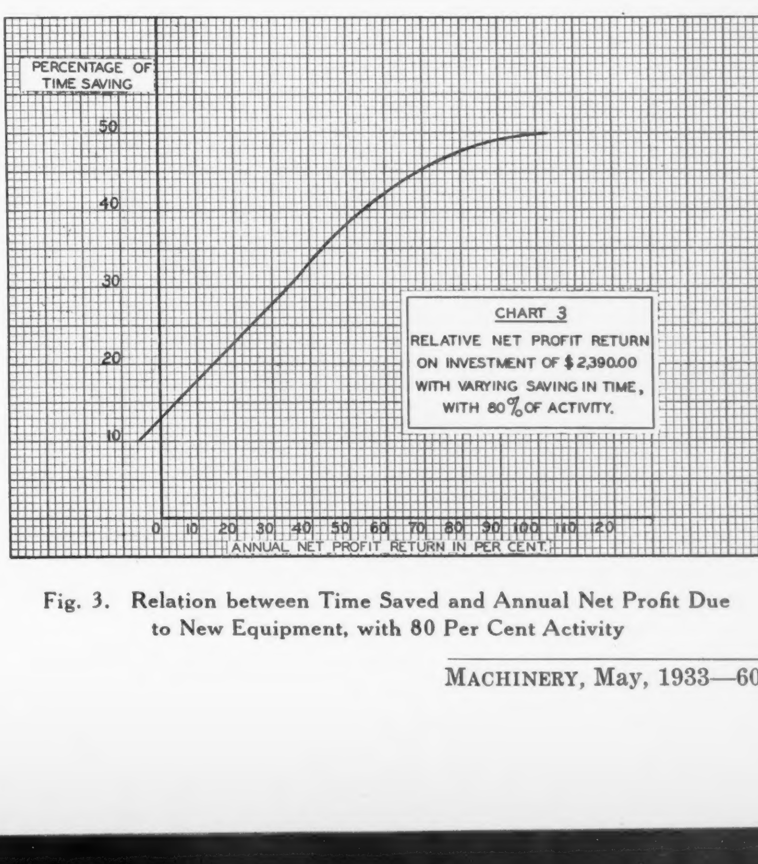



Fig. 3. Relation between Time Saved and Annual Net Profit Due to New Equipment, with 80 Per Cent Activity

sults with 100 per cent activity. Our original case showed an activity of 80 per cent when the net-profit return was 35 per cent. If the activity had been as high as 100 per cent, the net-profit return would have risen to 49 per cent. If the activity had only been 60 per cent, the net-profit return would have dropped to 20 per cent.

Hence, we are always vitally interested in determining how busy the machine will be. The buyer's organization, of course, knows far more about the possible field of application of new equipment than any salesman coming into the plant, once the general characteristics of the proposed equipment are known. We, therefore, invite the salesman to join our equipment supervisor in a thorough analysis of the work in the shop, in looking over completed jobs in the stock-room, and, perhaps, even in discussing new designs in the design department. Thus an estimate of activity is obtained that the production manager feels to be safe. Experience shows that the proportion of activity determined by a thorough analysis of the equipment supervisor, working with the seller, is always higher than originally anticipated, and that the actual rate of activity shown by later experience is still higher.

The importance of a careful study of this subject is apparent when we consider the buying process as a whole. The factory superintendent must prove to the chief executive an earning power, or net-profit percentage, of 15 to 20 per cent on the investment. If he fails to do so by even a slight margin, his request for equipment will be refused. In such cases, the factory executive asks himself, "What rate of activity must be reached before I can show a satisfactory earning power?" and figures it as follows:

| | | |
|---|---|---|
| The investment is.................... | | $2390.00 |
| The investment must earn | | |
| 20 per cent depreciation....... | $478.00 | |
| 20 per cent net profit.......... | 478.00 | |
| | $956.00 | |

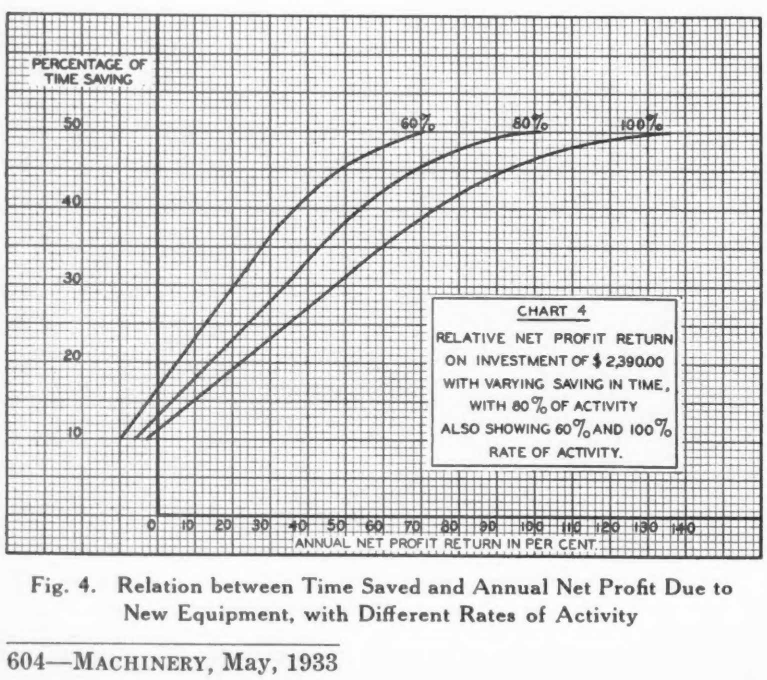



Fig. 4. Relation between Time Saved and Annual Net Profit Due to New Equipment, with Different Rates of Activity

The full-time saving per year shown in net-profit statement is: $136.88 per month times 12 month equals ......................$1642.56

The per cent of activity needed is:

$$\frac{\$956.00}{1642.56} \text{ equals....58.3 per cent}$$

This simple analysis clears up a hazy situation, and the shop superintendent then puts aside the matter until his activity reaches, in this case, 58 per cent, when he is justified in requesting the needed equipment. Our company has found from its own experience that a surprisingly low rate of activity will often justify the investment, particularly when the time saving is high or when the investment is low. For example, we purchased a hydraulic broach with an expected activity of only 45 per cent, but found after it had been put in use that the investment actually returned a net profit of 35.5 per cent.

### Reducing the Amount of the Investment

One effective way to secure approval of equipment requisitions is to bend every effort to obtain time savings with equipment costing as little as possible. If the investment can be lowered, the deduction from gross savings for depreciation will be cut, and at the same time the divisor of the equation that gives the net-profit percentage will be reduced. Moreover, a proposed investment of, say, $2000 is more likely to be approved by the chief executive than one of $4000.

Fig. 5 shows how rapidly the net-profit percentage can be increased by reducing the amount of the investment. Returning to our original illustration, the investment was $2390, with a net-profit percentage of 35 per cent. If it had been possible to obtain the same time saving with equipment that cost, for example, only $1500, the net-profit percentage would have been 70 per cent. On the other hand, if we had found it necessary to spend $4000, the net-profit percentage would have dropped to 10 per cent.

In considering the purchase of equipment, it is always advisable to compare the net results from different machines and tools, figuring net-profit statements for each type of equipment. In this way, the one best method can be ascertained, as judged by the net-profit return on the investment. It may happen that one type of equipment will give smaller time savings but a higher net return than a more elaborate installation, which cuts the time per piece rather spectacularly, but involves a higher investment.

Viewing the problem from the practical point of view of the shop executive, the decision may lie between different methods of machining, such as between

milling or planing, or between using a boring mill or a drilling machine for a given operation. In some cases, a more expensive type of equipment will bring a much higher net-profit yield. We have found, in our own shops, that turned work in lots even as small as eight to ten pieces may be often produced more profitably on a turret lathe than on a simpler and less expensive type of machine. On the other hand, automatic machines which were undoubtedly a wise investment in 1929 may or may not be a sound investment under present conditions of volume.

### Profitable Investments in Tools and Attachments

Again, a study of the equipment problem from the investment viewpoint emphasizes the high profit returns possible from investment in small tools, as, for example, standard tools and attachments for machines already on hand, multiple drill heads, gang milling cutters, grinding spindles, etc. The investment involved in this type of equipment is usually low—$100 or $200. Hence, relatively small savings in time and small rates of activity will quickly justify the investment. In this more simple illustration, we use for a measuring stick only the "time to repay," knowing that, as a practical rule, any small tool that will pay for itself in less than a year and that will last several years, has an earning power well in excess of 100 per cent.

Take, for example, a portable air tool costing $100. If such a tool saves only 25 per cent of the time when it is in use, and is in operation only six hours a day, it will pay for itself in approximately fifty-five working days or about two months. Generally speaking, any small tool that will make a saving large enough to measure definitely, will pay for itself in approximately one year. Probably the first items in our equipment purchases in the period ahead will be small tools with low investment cost, which can quickly pay for themselves and will develop earnings for investment in larger units.

In a general equipment problem, the net-profit statement has been found to be a simple workable approach, which may be prepared by the equipment supervisor, is easily understood by the treasurer, and appeals to the chief executive. The illustration we have used applies to equipment involving investments of $2000 to $4000. When larger investments are considered, it is necessary to use labor and overhead depreciation rates which apply to the particular equipment.

### Results Obtained with the Method Described

At the Warner & Swasey plant, various equipment replacements over a period of years, including such items as gear shapers, drills, grinders, etc., show the following average results:

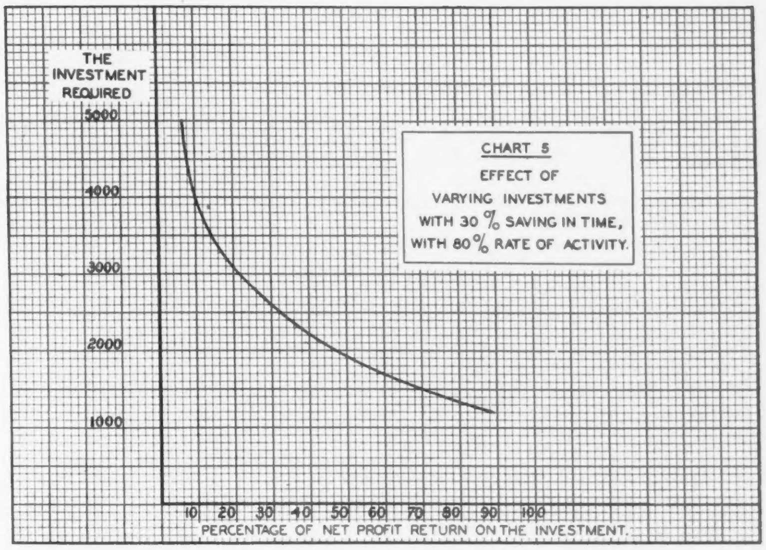



Fig. 5. Relation between the Amount of Investment Required for New Equipment and the Net-profit Return on the Investment

| | |
|---|---|
| The average reduction in time | 37.9 per cent |
| The percentage of activity | 83 per cent |
| The average investment | $3239 |
| The average time to repay | 22 months |
| The average net profit | 34.8 per cent |

In addition, we have found many intangible advantages, such as operating flexibility of machines, a better quality of finished product, the ability to use tungsten-carbide tools, savings in floor space, etc.

Most of us are busily engaged in attempting to rebuild our volume of sales. A vitally important factor in this effort is the cost of production. The importance of proper equipment in reducing costs is obvious to a group of engineers, but perhaps it is not clearly apparent to the treasurers who control the purse strings and to the chief executives who control equipment buying policies.

Factory executives have a splendid opportunity in the years ahead to demonstrate to their managements the gold mine of net profits that lies right in their own plant through the intelligent selection of equipment.

* * *

## Increasing Safety of Railroad Operation

The railroads of the United States are being operated with the greatest safety in their history, according to a report recently prepared by H. G. Warfel of the Safety Section of the American Railway Association. In 1931, only four passengers lost their lives in train accidents, three of whom were killed in the same accident. This is the smallest number of fatalities of passengers ever reported for any year by the railroads. During the first six months of 1932, no passenger lost his life in train accidents. In the last ten years, American railroads have made an improvement of 75 per cent in the safety of train operation.

# NEW TRADE  LITERATURE

***Recent Publications on Machine Shop Equipment, Unit Parts, and Materials. Copies can be Obtained by Writing Directly to the Manufacturer.***

NON-METALLIC GEARS. Synthane Corporation, Oaks, Pa. Wall chart giving physical characteristics and formulas for calculating Synthane laminated Bakelite gears. An original and useful feature of the chart is a collection of gear tooth sections, showing all the commonly used gear pitches, actually attached to the chart, so that the designer can note at a glance the size and form of gear teeth of different pitches.

SILENT GEARS. Spaulding Fibre Co., Inc., Tonawanda, N. Y. Pamphlet containing engineering and design information on Spauldite silent gears. The pamphlet describes where and how these gears may be used, outlines their properties, and gives data for computing horsepower, as well as complete tables of horsepower ratings for gears from 1 to 50 diametral pitch.

METAL COLORING AND OXIDIZING PROCESS. United States Research Corporation, 40 Twenty-first St., Long Island City, N. Y. Bulletin descriptive of "Coloral," a simple process for oxidizing and coloring aluminum and its alloys. An unusual feature of this catalogue is the fact that on the corner of each page is pasted an actual sample of metal colored by this process.

TITANIUM ALLOY. Titanium Alloy Mfg. Co., Niagara Falls, N. Y. Booklet entitled "TAM Daily Reminder," giving information pertaining to zirconium and titanium products and also containing a memorandum page for each day of the month. These little diaries are issued monthly and can be obtained by those interested upon application to the company.

BAKELITE. Bakelite Corporation, 247 Park Ave., New York City. Pamphlet entitled "Bakelite Laminated," containing information regarding the several forms in which this product is manufactured. Data on the properties and uses and directions for working are also included. The bulletin is profusely illustrated with examples of the many different uses for which this product is adapted.

SYNTHETIC PLASTICS. American Catalin Corporation, 230 Park Ave., New York City. Circular descriptive of the characteristics and uses of Catalin, a cast synthetic resin, furnished in solid form, such as rods, sheets, tubes, or special castings. It is used extensively for handles, levers, fittings for machinery, etc. An actual sample of the material is attached to the inside back cover, and the preceding pages are cut away so that the material can be seen on each page.

CLUTCHES. Twin Disc Clutch Co., Racine, Wis. Booklet entitled "Selecting the Clutch," containing information on the various points to be considered in selecting a friction clutch for different classes of service. The various types of clutches made by the concern and the applications for which each is especially suited are also described.

SLIDE FEEDS FOR PUNCH PRESSES. U. S. Tool Co., Inc., Ampere, N. J. Circular describing how the U. S. slide feed for punch presses speeds up production and cuts labor costs. The feeds are made in two sizes for handling stock up to 2 1/2 and 6 inches wide, respectively, with 3 1/2- and 8-inch lengths of feed.

ALUMINUM PRODUCTS. Aluminum Co. of America, Pittsburgh, Pa. Booklet entitled "Combatting Chemical Corrosion with Alcoa Aluminum," containing data on the chemical characteristics of aluminum and its behavior in contact with a variety of materials.

HONING MACHINES. Barnes Drill Co., 830 Chestnut St., Rockford, Ill. Bulletin 121, containing revised data on the honing process for the finish-machining of internal cylindrical surfaces, and a large number of illustrations showing the Barnes line of honing machines.

FELT-SEAL BALL BEARINGS. Fafnir Bearing Co., New Britain, Conn. Catalogue describing the construction of the single and double felt-seal ball bearings made by this concern. Tables of basic dimensions, mounting dimensions, and radial load ratings are included.

TACHOMETERS. Amthor Testing Instrument Co., Inc., 309 Johnson St., Brooklyn, N. Y. Circular 106, descriptive of a new automatic fixed-reading tachometer for speed measurement of revolving equipment, such as motors, pulley shafts, belt surfaces, etc.

PRECISION INSTRUMENTS. George Scherr Co., 128 Lafayette St., New York City, is issuing a monthly publication known as "Precise Production," containing information on various instruments used for testing and inspecting precision work.

OPTICAL TOOLS FOR INSPECTION AND TESTING. Adam Hilger, Ltd., 98 King's Road, Camden Road, London N.W. 1, England. Circular containing an article on optical tools for inspection and testing, reprinted from British MACHINERY.

BALANCING MACHINES. Tinius Olsen Testing Machine Co., 500 N. 12th St., Philadelphia, Pa. Loose-leaf circular, pages 21 to 26-C, illustrating and describing the Olsen-Lundgren Style S dynamic balancing machine equipment.

COPPER-MOLYBDENUM IRON. Republic Steel Corporation, Republic Bldg., Massillon, Ohio. Circular containing data on the properties, heat-treatment, working, and applications of Toncan copper-molybdenum iron.

RUBBER TANK LININGS. B. F. Goodrich Rubber Co., Akron, Ohio. Circular descriptive of Goodrich "Triflex" rubber linings in steel pickling tanks.

# *Shop Equipment News*

*Machine Tools, Unit Mechanisms, Machine Parts and Material-Handling Appliances Recently Placed on the Market*

## Hall Continuous Planetary Milling Machine

Planetary milling, which has been the feature for years of machines built by the Hall Planetary Co., Fox St. and Abbotsford Ave., Philadelphia, Pa., has now been applied to a high-production continuous type of machine fitted with a multiple number of Planetary milling heads. These heads operate on the principle fully described in an article that appeared in December, 1928, MACHINERY, page 241.

The precision of the machine members and the resulting accuracy of the work done by the machine in production are features of the new machine. It is claimed that work can be held to tolerances of ± 0.00025 inch in regular production.

On the machine illustrated, six vertical Planetary heads move continuously around a central column, giving various production rates depending upon the time of each cycle. The accompanying table shows estimated production times for typical parts. It will be seen that in the case of ball-bearing races formmilled in the bore and in the ball grooves, the production is 40 pieces per minute.

The machine will perform operations in the general class of thread milling (Planathreading) and circular milling (Planamilling). In many cases, several operations can be performed simultaneously. A partial list of standard automotive parts, in the manufacture of which continuous Planamilling can be applied, includes differential carriers and housings, automobile hubs, rear axle housings, shock absorber parts, ball and roller bearings, gear blanks and connecting-rods.

Planathreading done by the machine makes it particularly suitable for threading pipe fittings such as couplings, nipples, valves, tees, elbows and flanges. In ordnance work, shells of all sizes can be handled.

The six standard Planetary milling heads are all mounted on one large casting which revolves continuously about the central column, carrying with it also work chucking fixtures and the slides to which they are attached. The chucking fixtures automatically locate and chuck the work. A vertical motor drives a large ring gear for moving the milling heads and the work-holding units around the column. The milling spindles are driven by individual vertical motors and are equipped with independent feed controls. Likewise the chucking fixtures are equipped with individual fixture throw-outs, so that the operator can engage or disengage any of the six units.

A cam ring bolted to the stationary central column controls the milling feeds of the six Planetary heads, in other words, the radial feeds of the milling cutters. A similar cam ring provides automatic vertical movements of the six work-holding fixtures for unloading and for positioning the work to take roughing and finishing cuts.

In the operation of the machine, one attendant standing at the loading position unloads the automatically opened fixtures and reloads them with a fresh piece of work as they pass by.

### Production Time for Typical "Continuous Planetary" Operations

| Part | Material | Operation | Production per Minute | Production per 9-Hour Day |
|---|---|---|---|---|
| Pipe Coupling | High-carbon Steel | Thread-mill both ends simultaneously. Thread—8 5/8 inches pitch diameter, 3 1/2 inches long. | 2 | 1080 |
| Automobile Hub | Steel Forging | Form-mill two bearing seats, 2 and 5 inches inside diameter. Mill bores and shoulders. | 10 | 5400 |
| Ball-bearing Race | Chrome-molybdenum Steel | Form-mill bore and ball grooves. | 40 | 21,600 |
| Differential Carrier | Malleable Iron | Thread mill both ends simultaneously. | 8 | 4320 |
| Shock Absorber | Steel Forging | Finish-mill complete inside. | 10 | 5400 |
| Explosive Shell | Chrome-nickel Steel | Thread-mill shell nose. Thread—1 1/2 inches pitch diameter, 3/4 inch long. | 12 | 6480 |

Thus, one man tends the equivalent of six machines. The operator can change the cutters in 20 seconds while the equipment is running, by walking around the machine. The permanent setting of the spindles in the consecutive Planetary heads is such that as each cutter is reground it may be used in the next spindle for milling work to the same diameter as when new.

One of the advantages of continuous Planetary milling is that the production is "pegged" at a predetermined rate by timing gears which control the machine rotation. Attention is called by the manufacturer to the universality of the machine, it being pointed out that the machine has been designed for automatic loading from an adjacent conveyor; that two or more different pieces of work can be loaded into alternate chucking fixtures; that the machine may be equipped with as few as two heads; that in a production hold-up, as few as two heads may be operated; that the machine gives the "Planetary approach" or non-burring first thread in all thread-milled work; and that both roughing and finishing cuts can be taken on a part without rechucking.

In order to insure accurate work, the machine has been built to unusually close limits. Lapped spindle bearings, eccentric sleeves and main bearings insure rigid spindles. The chucking fixtures are tied directly to the milling heads to assure the same rigidity to the work.

In designing the machine particular attention was given to obtaining a pleasing appearance. The chief claim to beauty is in the rigid adherence to symmetry. Each head and its parts on one side of the machine match and balance the head and its component parts on the opposite side. This note of hexagonal symmetry has been carried out even in the main castings. Piping and wiring are carefully hidden, and bolt heads have been concealed or else sunk flush with the metal.

## Double-End Milling and Centering Machine

The Jones & Lamson Machine Co., Springfield, Vt., has developed an automatic machine for milling to length and centering

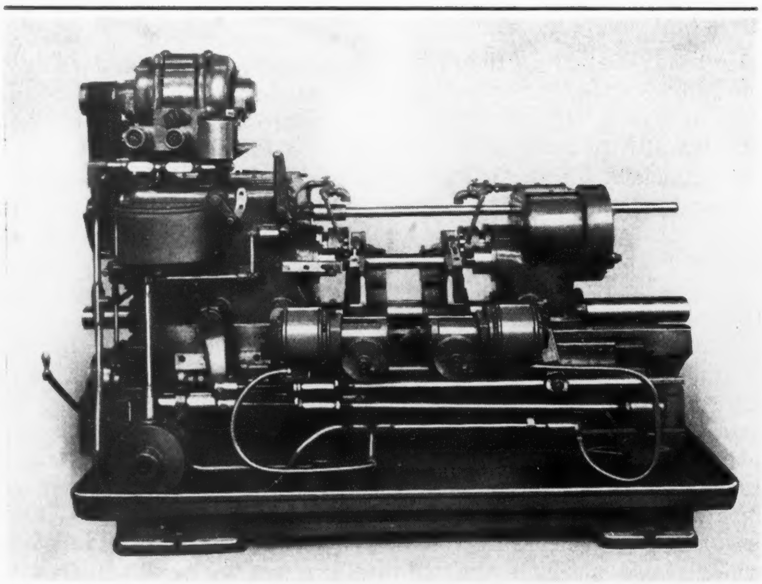


Fig. 1. Jones & Lamson Automatic Double-end Milling and Centering Machine

to uniform depth, both ends of shafts, stem gears, and similar pieces preparatory to turning operations. All movements of the machine are controlled by hardened cams on drums. The work-holding units are supported on hardened and ground former blocks, as may be seen in Fig. 3. Electric torque motors at the front of the machine, as seen in Fig. 1, clamp the work in the blocks. These motors are operated by a drum switch which is located in front of the driving-motor base.

The right-hand milling head is adjustable along the ways of the machine by means of a lead-screw located on the back of the bed, as shown in Fig. 2. Both work supports can be moved longitudinally on the center bar of the machine to suit various lengths of work. Fast motion of the machine is obtained through a multiple disk clutch and a drive shaft at the rear.

After the work has been clamped in the V-blocks by means of the electric torque motors, the machine is started by operating the upright lever at the front of the headstock. The work-holding units are then moved toward the milling cutters, and after the milling cuts have been completed, they carry the work to the centering position. When the center drills have withdrawn at the end of the centering operation, the machine stops.

For short work, the right-hand work-holding fixture can be removed and the right-hand cutter-head moved up so that the length of the work need only be greater than the width of the remaining V-block and holder. Standard equipment is designed for machining round stock from 3/4 to 3 1/2 inches in diameter, but the machine can be equipped to accommodate work up to and including 4 1/2 inches in diameter.

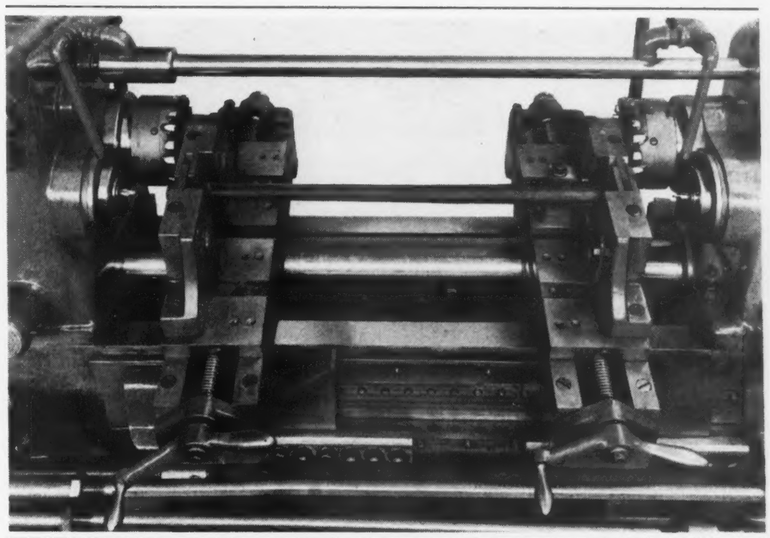


Fig. 3. Close-up View, Showing the Former Blocks for the Work-holding Units

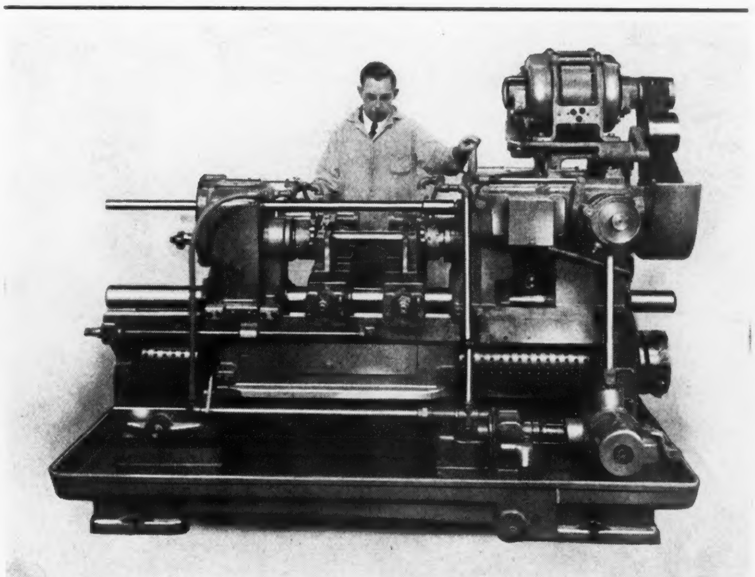


Fig. 2. Rear View, Showing Cam Drums, Lead-screw for Right-hand Milling Head, and Fast-motion Drive

## Oster-Williams Die-Head for Modernizing Old Pipe Machines

For the rehabilitation of old pipe-threading machines, Oster-Williams, Cleveland, Ohio, have brought out a die-head suitable for all sizes of pipe from 1 to 6 inches, and for bolts from 3/4 inch to 6 inches. The head is regularly calibrated for Briggs standard pipe threads, but it can be marked special to suit requirements. A micrometer adjustment for over- or under-size threads is supplied as standard equipment.

The threading dies are made of high-speed steel and are of the small segmental type, mounted in holders. The head is also equipped with a single high-speed steel cutting-off blade. Reaming and chamfering of pipe is accomplished in one operation by means of a special forming tool mounted on the cut-off slide. The head can be adapted to cut tapered threads up to 4 inches long for oil-field work and similar service.

## Greenlee Vertical Indexing Machine

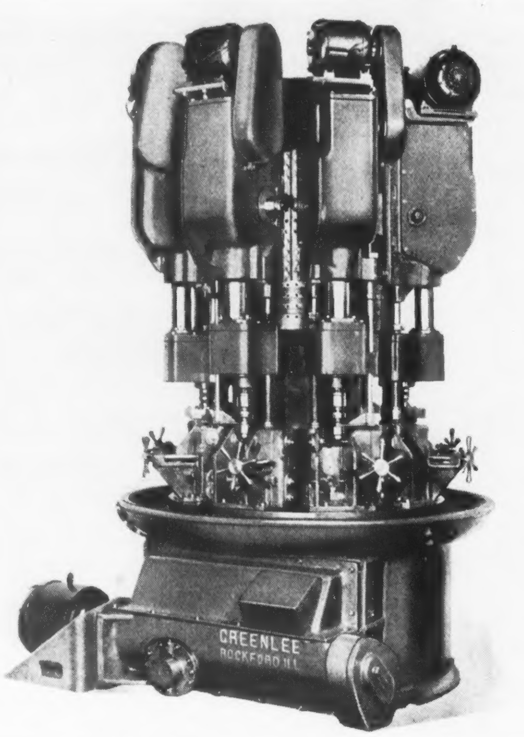


Fig. 1. Greenlee Vertical Indexing Machine with Tool-heads Fed by Cams on an Oscillating Drum

A vertical indexing machine of the oscillating cam feed type has been developed by Greenlee Bros. & Co., Rockford, Ill., for performing multiple operations on work produced in large quantities. Such operations as drilling, boring, reaming, counterboring, spot-facing, milling, threading, and tapping can be performed on a large variety of parts, including those illustrated in Fig. 2.

The machine consists essentially of a base which supports a table that indexes automatically. On a circular column in the center of the machine is mounted a group of quill-feed drive units to which single- or multiple-spindle drilling, boring, and milling heads can be attached. Different numbers of indexings for each table revolution can be arranged for, one station being used for loading. To change the number of indexings per revolution of the table, it is merely necessary to change one gear.

Each drive unit has an individual motor drive to its spindle through a silent chain and sprockets. Feeding is accomplished by segment cams mounted on an oscillating drum carried on the column. The tool-heads can be designed to accommodate a large number of spindles if desired.

The machine here shown has seven operating positions and one loading position. It is equipped for rough- and finish-facing the cap seats of the automobile connecting-rods seen at *E* in Fig. 2, and for crowning, turning, and threading the studs that are integral with these rods.

At *A* in the same illustration is shown a differential gear-case in which nine holes are drilled, countersunk, and reamed by the new machine. At *B* is shown a steering spindle on which drilling, reaming, spot-facing, end-milling, and chamfering operations are performed. The flywheel shown at *C* has six holes drilled and reamed in the center, and twelve holes drilled, countersunk, and tapped along the rim. At *D* is shown a ring gear in which nine holes are drilled, countersunk, and reamed.

## Producto Automatic Cam Milling Machine

Two cam paths, surfaces, or contours can be milled simultaneously on the same piece in

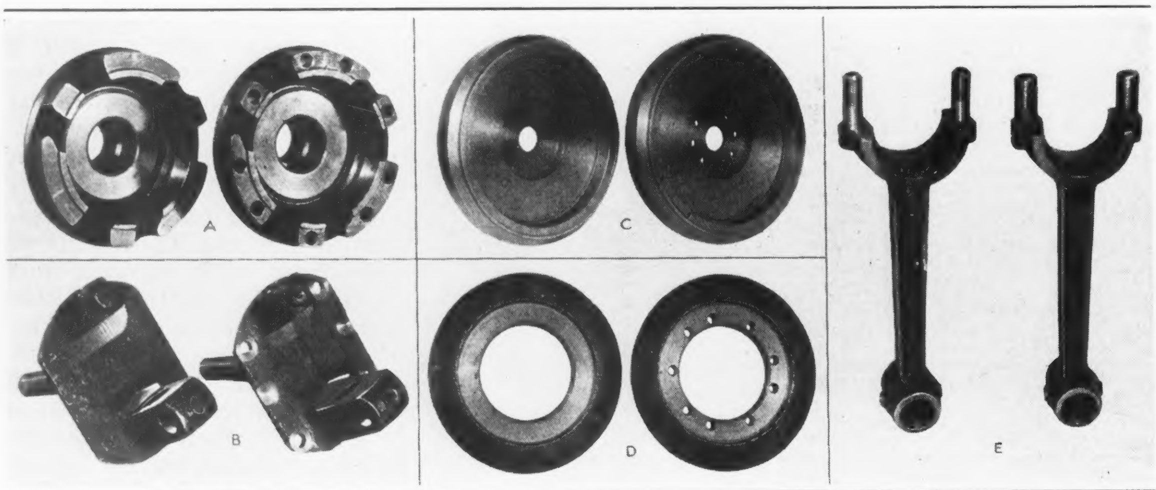
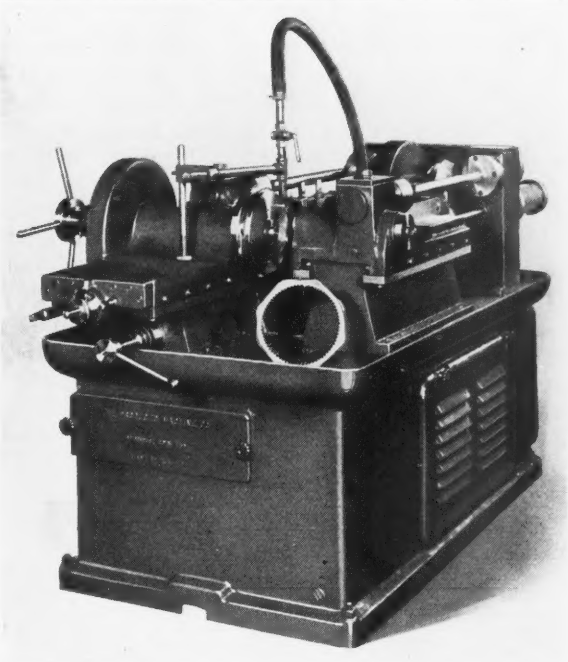



Fig. 2. A Variety of Parts Drilled, Reamed, Tapped, etc., on the Greenlee Vertical Indexing Machine

an automatic cam milling machine recently added to the line of the Producto Machine Co., Bridgeport, Conn. Such operations are possible through the provision of two cutter-slides and one work-slide. Separate master cams are used to control the action of the cutter-slides, thus enabling different cam contours to be produced on the same piece.

The particular machine illustrated is equipped for milling two paths on a timing or valve lift cam used on radial-type airplane engines. The cam is about 10 inches in diameter by 5/8 inch wide, the cam paths being each 1/4 inch wide. From a rough forging, a smooth finish is produced ready for hardening and finish-grinding. Each cam path has four lobes. One piece is completed in from seven and one-half to eight minutes.

The machine is fully automatic in operation. The work can be clamped in the work-spindle by a handwheel, as shown, or by air chucks. Force-feed lubrication is supplied to all shafts and bearings, and there is a system for delivering coolant to the cutters. An attachment can be provided for producing master cams from a sample or model of the work itself. This enables the machine to be used on a wide variety of parts.



Automatic Producto Cam Milling Machine which Mills Two Cam Paths at One Time

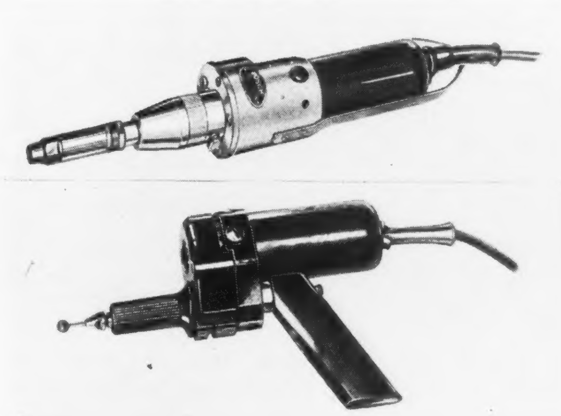
## American Bosch Electric Screwdriver and Die-Grinder

The automatic screwdriver and nut-setter and the high-speed die-grinder here illustrated are forerunners of a full line of electrical tools to be placed on the market by the United American Bosch Corporation, Springfield, Mass. Compactness is a feature of both tools. The automatic screwdriver has an outside diameter of only 2 inches and weighs only 3 3/4 pounds. It has an automatic pressure clutch which is adjustable, and a fan-cooled universal motor. A stationary centering sleeve with a self-centering bit provides an accurate adjustment for all types of screws and nuts, preventing damage to the heads.

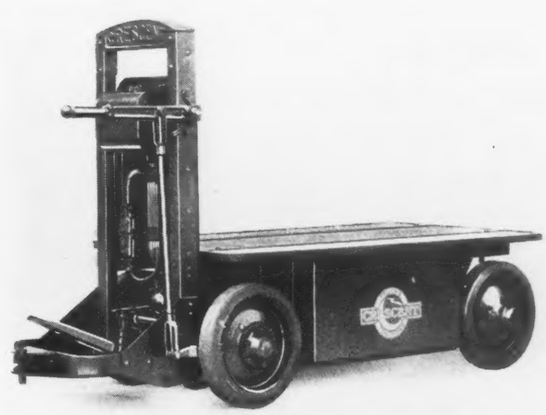
The die-grinder is intended for such operations as finishing patterns and dies. It has a spindle speed of 50,000 revolutions per minute. Wheels from 5/64 to 5/8 inch in diameter can be used for grinding to small radii and in inaccessible places.

## Crescent One-Ton Truck for Small Plants

A truck developed by the Crescent Truck Co., Lebanon, Pa., primarily for use in small plants where the loads average



(Above) Automatic Electric Screwdriver and Nut-setter; (Below) High-speed Die-grinder



Crescent Truck Developed for Handling Loads of Approximately 2000 Pounds

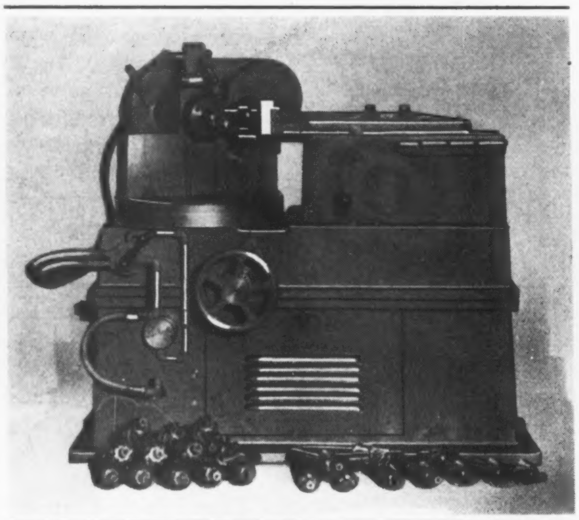
about 2000 pounds is shown in the accompanying illustration. This truck is equipped with a twelve-cell storage battery. It has an over-all length of 75 inches and an over-all width of 33 inches. The platform measures 58 by 33 inches.

The turning radius is such that the truck can be operated in 52-inch intersecting aisles. The wheels are equipped with press-on type rubber tires, and are mounted on Timken roller bearings. A General Electric motor drives the truck through worm-gearing. The weight of the truck complete, with battery installed, is approximately 1300 pounds.

## Bilgram Gear Chamfering Machine

A machine designed especially for chamfering spiral-bevel gears, but which will also chamfer other types of gears, has been added to the line of the Bilgram Gear & Machine Works, 1217-35 Spring Garden St., Philadelphia, Pa. On spiral-bevel gears, the machine removes the feather-edge produced in cutting the teeth, which otherwise would be likely to crack off when the gear was placed in service and cause damage. The machine is intended primarily for production work and will chamfer more than 100 gears an hour.

The tool-head on the front of the ram is equipped with two tools for chamfering both ends of a tooth at each stroke. A chuck for holding the gears may be operated either by compressed air or hydraulic pressure. The headstock is adjustable to any angle up to 90 degrees. Gears up to 18 inches in diameter, irrespective of the number of teeth, as well as pinions having as few as five teeth, can be handled.



Bilgram Machine for Chamfering Spiral-bevel Gears and Other Types


Kane & Roach High-speed Cold-roll Forming Machine of the Outboard Bearing Type

## Self-Locking Copper Lining for Burnishing Barrels

The Abbott Ball Co., Hartford, Conn., has developed a self-locking copper lining for ball burnishing barrels. The design of the lining is such as to set up an additional movement of the work and balls in the barrel, thus producing the desired finish more quickly. The lining itself also acts as a burnishing medium. Application has been made for a patent.

## Kane & Roach Cold-Roll Forming Machine

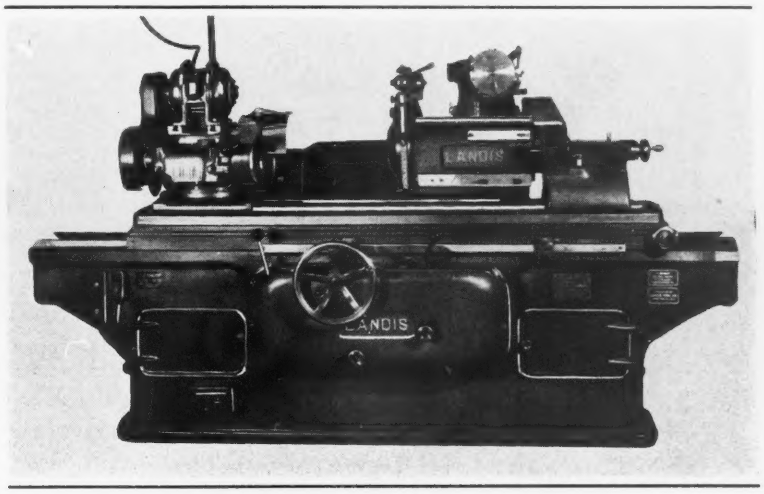
A cold-roll forming machine equipped for rolling tin-coated copper stock into automobile radiator tubes at the rate of 270 feet per minute is shown in the accompanying illustration. This machine is the latest development of Kane & Roach, Inc., Syracuse, N. Y. It can be furnished with different numbers of roll stands and in several sizes, for rolling a large variety of shapes and sections.

Power is delivered from a motor through V-belts to a lineshaft which drives a series of worm reduction units. Each of these units, in turn, drives a number of roll stands. The motor is mounted on a hinged sub-base that permits adjustments to be easily made for taking up slack in the V-belts. The machine is equipped throughout with anti-friction bearings.

## Hand-Operated Starter in Splash-Proof Cabinet

An addition has been made to the standard line of starters manufactured by the Allen-Bradley Co., 1311 S. First St., Milwaukee, Wis., in the form of a splash-proof hand-operated starter for motors up to 3 horsepower, 110 volts; 5 horsepower, 220 volts; and 7 1/2 horsepower, 440 to 550 volts. The start and

stop buttons operate the mechanism without a magnetic coil. Overload breakers disconnect the starter after a sustained overload. The cabinet is cadmium-plated. Splash-proof push-buttons in the cabinet cover actuate the switch and exclude moisture from the mechanism.

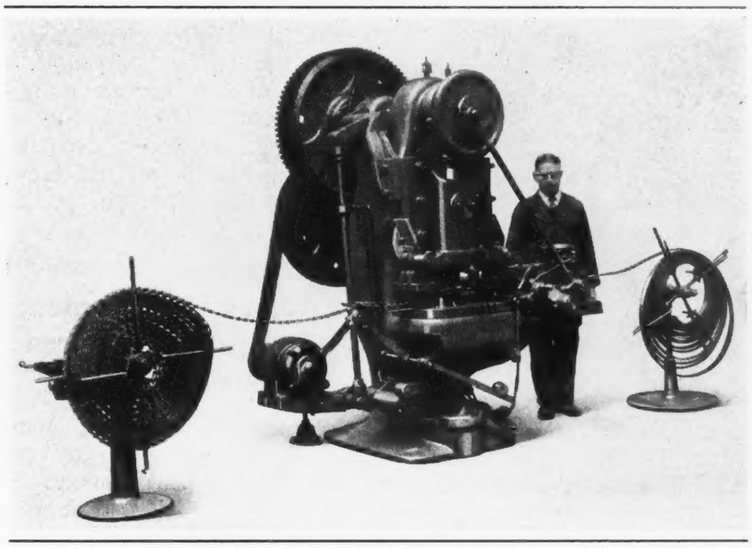



Landis Type C Hydraulic Universal Grinding Machine with a Swing of 14 Inches

## Ferracute Chain-Making Press

A special power press which makes chain from strip stock at the rate of forty links a minute was recently built by the Ferracute Machine Co., Bridgeton, N. J. Strip stock 1 3/8 inches wide by 3/32 inch thick is fed into one end of the die equipment, as illustrated, and comes out in the form of chain at the opposite end of the dies.

Seven operations are performed while the stock passes through the dies, as follows: Score sides to a V-shape top and bottom; score end of hole top and bottom with a V-shaped punch; lance end; partially form or curl the metal lanced in the preceding step; form end of link, score top and bottom, and further form; break scoring at end of link; and finish curl, locking links together. The machine weighs 10,000 pounds and is driven by a 5-horsepower motor.



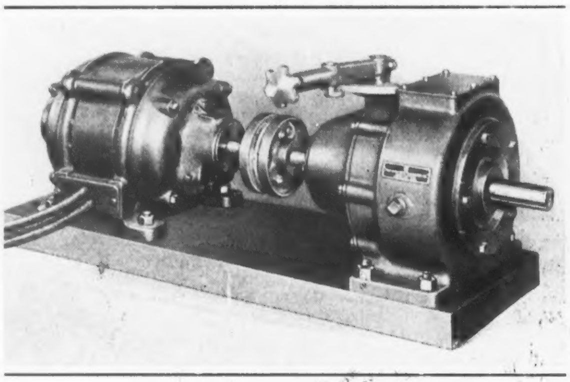
Ferracute Press which Makes Chain from Strip Stock at the Rate of Forty Links a Minute

## Landis Hydraulic Universal Grinder

A 14-inch universal machine has now been added to the line of Type C hydraulic grinders built by the Landis Tool Co., Waynesboro, Pa. In designing this machine, the aim was to give it all the flexibility that a universal type of grinder should have and, at the same time, especially adapt the machine for quantity production service. Particular attention is called to the weight, the 14- by 36-inch machine, for example, weighing 7650 pounds without the electric motors. It is pointed out that the weight and strength have been placed where rigidity and wearing area are needed.

An exclusive feature of this machine is the double-cylinder type hydraulic table-traversing mechanism, which insures smoothness of the table traverse and reverse at all speeds. An almost infinite number of table speeds are available which, in combination with the multi-speed headstock, enables the operator to select work and table speeds to suit any particular part being ground. The headstock can be swiveled up to 90 degrees for face grinding, and the wheel-base can be swiveled up to 90 degrees either side of the center. A sub-slide provides for moving the head forward or backward as the nature of the work requires.

Standard equipment includes an anti-friction bearing type of internal grinding fixture, a chuck for internal and face grinding, an automatic hydraulic wheel-feed mechanism, a center rest, and cutter tooth rests of stationary and traveling types. Rotary magnetic chucks and loose cam-grinding heads can also be supplied. Hydraulically operated tooling can be used. The machine is built in three lengths of 36, 48, and 72 inches.

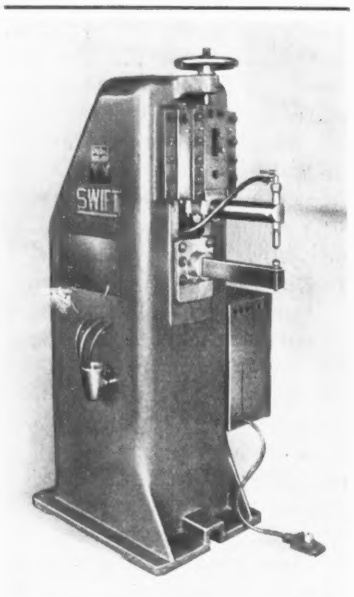


Johnson Speed Reducer Based on the Over-running Clutch Principle

Bench Lathe of Simplified Design Made by the South Bend Lathe Works

## Johnson Variable Speed Reducer

A speed reducer that gives any output speed from 0 to 240 revolutions per minute, has been placed on the market by the Smith Power Transmission Co., Penton Bldg., Cleveland, Ohio. For speeds above the maximum mentioned, a step-up drive can be applied to the output shaft. The various speeds are obtained by changing the stroke of five arms attached to a similar number of one-way over-running clutches. This change is made by means of a variable-throw crankshaft arrangement, controlled by the hand-lever shown.



Swift Air-operated Automatic Spot-welder

The lever control can be locked in any position by a handwheel. A dial indicates the speed of the output shaft. All moving parts are mounted in ball or roller bearings. In the illustration, the reducer is shown connected to a one-horsepower motor that runs at a speed of 1200 revolutions per minute.

## Air-Operated Automatic Spot-Welder

The Swift Electric Welder Co., Detroit, Mich., has brought out an air-operated automatic welding machine for the production spot-welding of steel, stainless steel, aluminum, brass, and copper. Six points of heat regulation are provided for welding a wide range of work up to a combined thickness of 1/4 inch in steel.

A small air cylinder operates through a toggle to apply pressure to the work. The upper head of the machine is equipped with a graduated handwheel for vertical adjustments, thus permitting a quick set-up for any job. Change-gears provide a wide range of speeds up to 180 ram reciprocations per minute.

A multiple-tooth clutch, controlled by a magnetic switch and a foot-switch, drives the machine. An anti-repeat interlock switch prevents the machine from repeating, even though the operator fails to take his foot from the pedal. This interlock can be disconnected for rapid repeat welding.

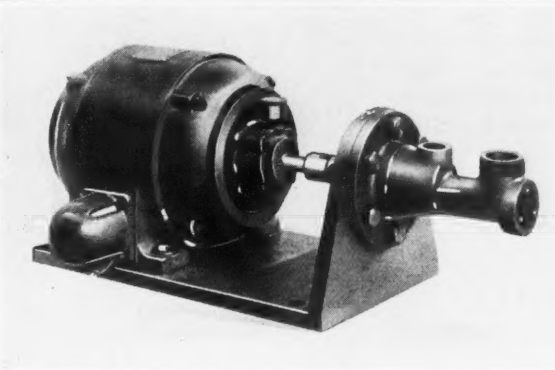
## South Bend Bench Lathe

A simplified metal-cutting bench lathe of 9-inch swing, designed to sell at a low price, has been placed on the market by the South Bend Lathe Works, 426 E. Madison St., South Bend, Ind. This lathe, the result of two years of development work, is of the back-geared screw-cutting type. It is mounted on pedestal style legs, and has a triple V-way bed of steel and iron mixture. The one-quarter horsepower motor for the horizontal drive may be mounted on the bench or on the wall. A control switch for the motor is attached to the bed at the extreme left-hand end of the lead-screw. This machine is also available with a countershaft drive.

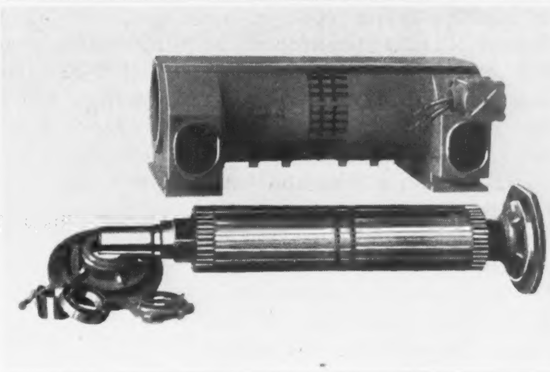
All standard screw threads from 4 to 40 per inch can be cut with this lathe. The machine will also perform straight and taper turning, boring, reaming, drilling, cutting off, buffing, and grinding. It can be fitted with attachments for milling, keyway cutting, and other operations.

## Rotary Displacement Pumps for Oil-Fired Furnaces

Rotary displacement pumps embodying the pumping principle described in January, 1933, MACHINERY, page 361, and designed particularly for use in the operation of oil-fired furnaces, have been brought out by the



De Laval-IMO Rotary Displacement Pump of Small Size



A 100-H.P. Motor that is Less than 12 Inches in Diameter

De Laval Steam Turbine Co., Trenton, N. J. The principal advantage claimed for these pumps, which are driven by an electric motor or by a steam turbine, is that the pumping action insures a steady pressure on the delivered oil. The illustration shows a small motor-driven pump designed to supply bunker C oil at 100 degrees F. at the rate of 2 1/2 gallons per minute, with a pressure of 100 pounds per square inch. The motor is of 1/2 horsepower and runs at 3450 revolutions per minute.

A direct-coupled steam turbine driven unit, which has a speed of 3000 revolutions per minute, delivers 150 gallons of light fuel oil per minute at a pressure of 150 pounds per square inch. Another unit, which has a gear speed reducer interposed between a steam turbine and the pump, has a capacity of 90 gallons per minute, when handling a heavy fuel oil, at a pressure of 300 pounds per square inch. This pump can be used for pressures as high as 500 pounds per square inch.

## 100-Horsepower Motor Only 12 Inches in Diameter

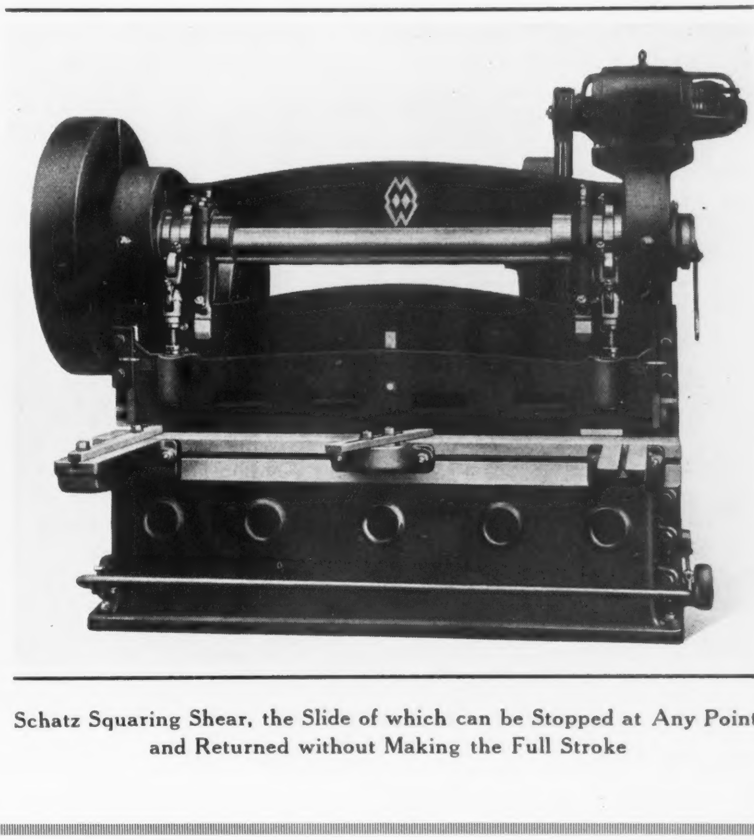
An unusual development in the electric motor field is a 100-horsepower motor that is less than 12 inches in diameter. This motor is made by the Louis Allis Co., Milwaukee, Wis.

The new motor is intended for use with direct-mounted grinding wheels, saws, cutter-heads, etc., when the diameter of the cutting tool must be held to a minimum.

## Squaring Shear which Can Make Partial Strokes

A line of squaring shears has recently been placed on the market by the Schatz Mfg. Co., Poughkeepsie, N. Y., in which the slide can be stopped instantly at any point of its stroke and then returned without completing the cycle. Thus a plate can be cut into any desired amount instead of a complete cut being made. This permits considerable savings to be made in the preparation of many blanks.

The presses are equipped with a multiple-disk friction clutch and brake. A beveling attachment provides for cutting Y or V welding edges. There is also a



Schatz Squaring Shear, the Slide of which can be Stopped at Any Point and Returned without Making the Full Stroke

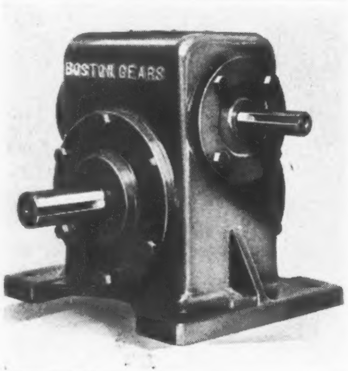
side shear, which consists of cross-cut blades positioned at right angles to the long shear blades. In trimming a narrow strip from a long plate, the side shear snips off the trimmings at the end of each stroke and thus facilitates further feeding.

The shear blades are longer than the space "between the housings." For instance, on a machine that measures 10 feet between the housings, the actual length of the shear blades is 11 feet 8 inches. Machines with the multiple-disk friction clutch are available in eighty sizes, while smaller shears with a steel-bolt clutch are furnished in twenty-six sizes.

## Boston Worm-Gear Speed Reducers

Worm-gear speed reducers of the style illustrated are now being made by the Boston Gear Works, Inc., North Quincy, Mass., in ratios ranging from 10 to 1 up to 100 to 1, and in horsepower ratings from 1/6 to 3, inclusive. The worm is located above the worm-gear, so as to bring the heavily loaded shaft as close to the foundation bolts as possible. The shaft diameters are large, making outboard bearings unnecessary, except in cases where an unusually long shaft is required.

These speed reducers are leak-proof when the oil is maintained at the proper level, due in large measure to the fact that the high-speed shaft is above the oil level. Timken tapered roller bearings are supplied for both the high- and low-speed shafts. Motorized styles of this line of speed reducers can be made up with alternating-current motors.




Boston Worm-gear Speed Reducer Made in Sizes from 1/6 to 3 Horsepower

## Air Cell Battery for Brown Potentiometers

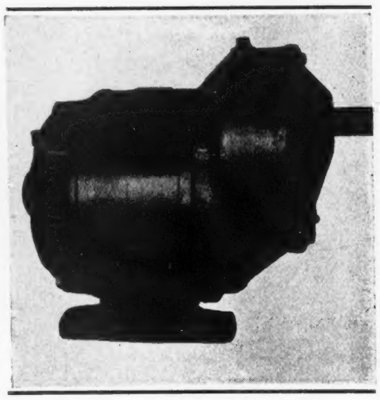
The Brown Instrument Co., Philadelphia, Pa., has developed a battery for use with all types of potentiometers made by the concern. This battery enables potentiometer pyrometers to record or control temperatures accurately without the necessity of frequent standardizing. With this battery, a potentiometer will operate at least one month without standardization.

Brown Compensated Air Cell for Use with Potentiometers

This battery, which is known as the "Brown Compensated Air Cell," is a wet type, non-rechargeable battery. It is shipped dry and rendered active by adding cool drinking water. Its name is derived from the principle of air polarization on which it operates, oxygen being obtained from the air rather than from compounds in the battery.

## Westinghouse "Gearmotors"

A line of "Gearmotors"—motorized speed reducers—with an over-all length scarcely greater than that of the motor itself, has been developed by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. These units are designed for drives of from 1/2 to 75 horsepower rating and for speeds from 1550 down to 232 revolutions per minute. They can be connected direct to the driven equipment or through "Cog-Belts," chains, or flat belts. Fourteen reduction ratios are available for each motor speed and horsepower rating. Changes in output speeds can be readily made. The helical gears which give the reduction run in an oil bath.



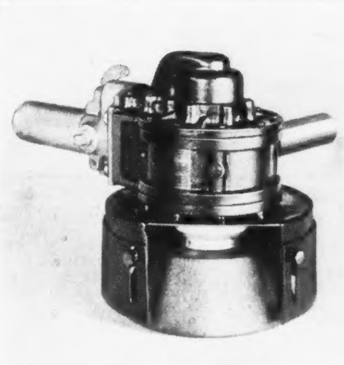
"Gearmotor" of a Length Hardly More than the Motor Itself

## Ace Metal Spray Gun

An Ace spray gun that will spray lead, tin, cadmium, bismuth, and other metals having a melting point under 650 degrees F., is manufactured by the Advance Engineering Co., Duncannon, Pa. This gun is intended for a wide variety of uses, such as filling hollow spots on metal parts, blow-holes, etc. As much as two pounds of metal can be sprayed per minute. The gun is operated by compressed air. It is connected to an acetylene tank.

## Rotor Portable Surface Grinder and Disk Sander

The portable surface grinder and disk sander here illustrated has recently been added to the products of the Rotor Air Tool Co., 5704 Carnegie Ave., Cleve-



Rotor Portable Tool Made in Several Models for Various Purposes

land, Ohio. This device is made in several models for various uses. For grinding operations, there is a model having a speed of 5500 revolutions per minute. A straight-side cup-wheel is generally used on this model for obtaining smooth flat surfaces. On welds, a flaring cup-wheel enables the operator to watch the removal of the excess metal closely and grind it away to a level with the adjoining metal. An unusually large combined radial and thrust bearing carries the load.

A model that runs at 3600 revolutions per minute is used with a cup-shaped wire brush for removing rust and scale from pipe, structural iron, etc. When a fine finish is desired on metal surfaces, a model having a speed of 4700 revolutions per minute is supplied, equipped with a 9-inch flexible sanding pad and abrasive disks.

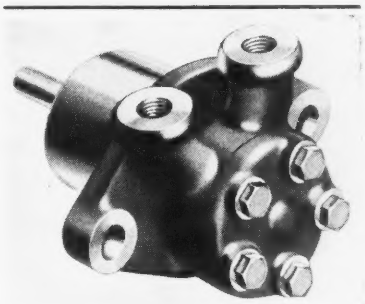
All these tools have an automatic quick-acting governor that prevents racing of the motor.

## Mercrelay Mercury Switches

Mercury switches with a fused quartz cup at the point where the arc occurs have been placed on the market by the General Wire & Switch Co., 140 Benedict St., Providence, R. I., under the trade name of "Mercrelay." These switches are made in several types with different electrical ratings. The advantages claimed are dependability, safety in the presence of combustible gases or inflammable materials, compactness, silent operation, and operation by a slight mechanical motion.

## Sundstrand Rota-Roll Pump

A pump that can be supplied with either a flange or a foot type of mounting for application to oil burners or for use in industrial installations has been brought out by the Sundstrand Machine Tool Co., Rockford, Ill. One of the features of this pump is a rotary seal, which is provided by the rolling action of the pumping members. The pumping members consist of a roller and a rotor which revolve in a manner similar to a roller and the outer race of a roller bearing. The pumping action is obtained by means of the rotary seal, the fluid being emptied ahead of the seal through the outlet port.



Rota-Roll Pump for Industrial and Oil-burner Applications

The pump has a capacity of 20 gallons per hour at a pressure of 100 pounds per square inch, with a motor speed of 1800 revolutions per minute. It is driven direct by motors running at speeds of either 1200 or 1800 revolutions per minute.

## Murex Straight-Gap Welding Process

An arc-welding process that does not require the cutting of grooves or vees in the plates to be joined is being introduced to the trade by the Metal & Thermit Corporation, 120 Broadway, New York City. This "Murex Straight-Gap" welding process is particularly suited for welding heavy plates together. The plates can be used just as they come from the steel mill.

The same company has also made an addition to its line of heavy mineral-coated electrodes. The new electrode is known as "Murex universal," and is intended for use on mild steel. It can be employed on flat, vertical, or overhead work.

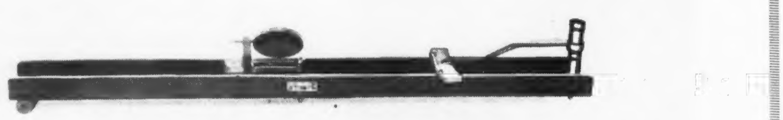
## Stanley Speed Variator

A transmission unit which gives an infinite number of speeds within a range of 3 to 1, delivering a constant horsepower at all speeds, is being introduced to the trade by the Merritt Engineering & Sales Co., Inc., Lockport, N. Y. This Stanley "Speed Variator," as it is called, is designed on the principle of roller traction.

Three pairs of rollers arranged radially about the output power shaft are positively driven by a built-in motor. A pair of disks secured to the output shaft receive their motion through contact with the rollers. Various speeds of the output shaft are obtained by adjusting the pairs of rollers radially. The resistance to slippage between the rollers and disks in all cases exceeds the overload capacity of the motor.

Speed Variator which Delivers a Constant Horsepower at All Speeds

This speed variator is made in three types, two of which contain speed reduction gearing to provide ranges of low speeds that are otherwise not available. The variator is made in ratings from 2 to 20 horsepower. Special units can be supplied with a maximum speed range of 9 to 1.



Precision Instrument for Determining the Flatness of Surfaces

## Eclipse Air Gun of Simplified Design

Among the advantages claimed for a Model G-6 air brush which has recently been placed on the market by the Eclipse Air Brush Co., Inc., 79 Orange St., Newark, N. J., are an "out-in-the-clear" fluid plunger packing chamber, and greater capacity for applying all types of coating materials. This gun has a variable trigger-tension adjustment. Regulation of the flow of sprayed material is accomplished by means of a knurled nut adjustment. The width of the spray can be varied to suit the operator and working conditions. This air brush employs the Eclipse fan-slot internal-mix nozzle.

## Van Keuren Flatness Tester

A flatness measuring instrument designed to obtain the same precision in measuring machined, ground, scraped, or dull-lapped surfaces that can be obtained with the optical flat on highly finished steel surfaces is being introduced to the trade by the Van Keuren Co., 12 Copeland St., Watertown, Mass. This instrument consists of a channel which supports a cylindrical line contact at one end, a micrometer with a spherical contact at the other end, and a sensitive light-wave indicator with a spherical contact in the center.

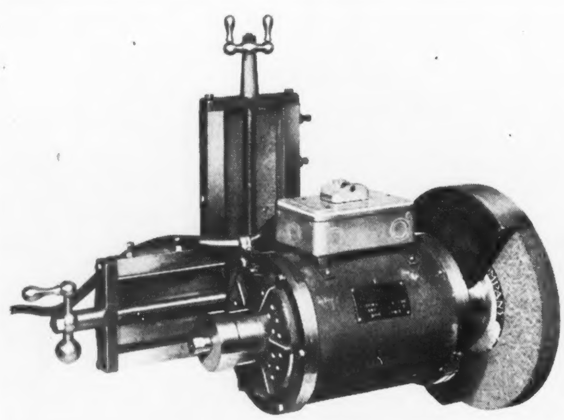
Means are provided for changing the positions of all three contacts to permit measuring different surfaces, such as ring-shaped laps, surface plates, or machine ways. Auxiliary flat contacts are provided for testing machined or scraped surfaces in order to detect local hollow spots.

In use, the micrometer end of the instrument is lowered on the surface to be tested until a slight movement of interference bands on the indicator shows contact of the center point. The micrometer then shows the amount that the surface is convex or concave.

## Angle-Plate Grinder with Horizontal and Vertical Feeds

The angle-plate grinder here illustrated has been developed by the Standard Electrical Tool Co., 1938-46 W. 8th St., Cincinnati, Ohio, for special roll or parallel grinding. This device is adapted for use on lathes, planers, boring mills, or milling machines. On the last-named machine, it can be used for grinding large milling cutters. It can also be employed for grinding large shear blades in place on shearing machines.

The illustration shows a two-horsepower machine with a horizontal feed of 11 inches and a vertical feed of 6 inches. The machine can be arranged with longer or shorter feeds or it can be provided with one feed only. It carries a 12-inch diameter wheel with a face width of 1 1/4 inches. In addition to the 2-horsepower size, 1/2-, 1- and 3-horsepower sizes are available.



Angle-plate Grinder Applicable to Various Machine Tools

## Ramet Tantalum-Carbide Tools for All Metals

Tantalum-carbide tools of different grades for cutting, drawing, and working all metals are now being made by the Ramet Corporation, a subsidiary of the Fansteel Products Co., North Chicago, Ill. Grade A is intended for general service in machining metals that produce edge wear and develop only a slight tendency toward cratering. This includes such metals as aluminum alloys, brass, bronze, cast iron, cast-iron alloys such as are used for centrifuse brake drums, malleable iron, and semi-steel having a steel content not greater than 20 per cent. Grade AA is similar to grade A, but it has been especially developed for taking intermittent cuts and for other heavy-duty applications that involve rough handling and shock.

Grade B is intended for cutting materials when there must be a combined resistance to cratering and edge

wear, as in machining cast alloys used for crankshafts, etc., having a hardness of 300 Brinell or more, cast steel having a hardness of from 300 to 400 Brinell, steels heat-treated to a hardness of above 300 Brinell and steel screw stock with a high sulphur and phosphorus content (S A E 1112 and 1120).

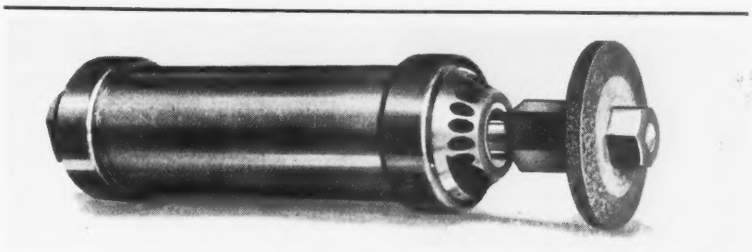
There is also a Grade C for soft steels which have the greatest tendency to cause cratering. In general, steels below 250 Brinell in hardness are included in this class. Grade D is similar to Grade C, but it is intended for harder steels, ranging from 225 to 300 Brinell, and for high-speed operations. This grade is especially suitable for taking light fast cuts on steels below 250 Brinell. Grade X has a high resistance to both cratering and edge wear, which makes it suitable for operations on very hard steels (above 450 Brinell) and for manganese steels having a manganese content of from 12 to 14 per cent.

Wire, tubing, and extrusion dies have been made from special grades of Ramet to obtain certain characteristics. The ability to withstand corrosion is an advantage when parts are used in connection with acid dips or washes.

## Magnetic Brake for Janette Motorized Speed Reducers

The Janette Mfg. Co., 556-558 W. Monroe St., Chicago, Ill., has developed a magnetic brake for instantaneously stopping the motorized speed reducers made by the concern. This brake is of the solenoid type and is mounted on the front end-frame of the motor. A steel case encloses the entire brake mechanism.

The brake makes the reducers applicable to machines that require instantaneous stopping when a piece of work is completed. It also makes possible the use of repulsion-induction motors on speed reducers connected to machines that require quick reversing.



Motor-driven Tool for Grinding the Inside of Tubes

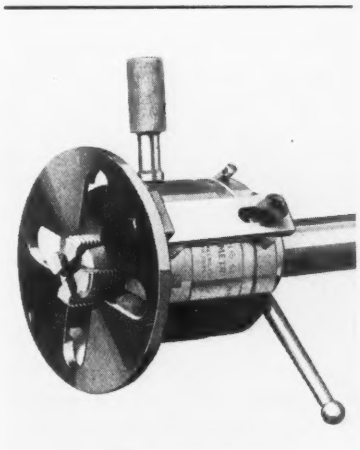
## Liberty Internal Tube Grinder

A motor-driven portable grinder of the design illustrated was recently made by the Liberty Mfg. Co., Jeannette, Pa., for grinding the inside of stainless steel tubes 3 1/2 inches in diameter. The motor is of a muffled design, providing quiet operation. Tools of this type are also used for cleaning out tubes that have become coated with scale in service.

## Geometric Collapsing Taps

Collapsing taps, which are designed for wide use in shallow depth tapping—that is, short thread lengths—and are particularly suitable when it is necessary to clear obstructions or projections at the bottom of a hole, have been added to the line of thread-cutting tools made by the Geometric Tool Co., New Haven, Conn. These Class PS taps can be tripped by the conventional trip-plate or they can be lever-tripped without extra parts. For use as a lever-tripped tap, a stop can be arranged on the cross-slide of the machine to come in contact with the long handle at the rear of the tool body.

These taps are built for use as stationary taps only. The closing action is at right angles to the axis of the tool. The chasers are opened and closed by cams. After a thread has been cut to the desired depth and the chasers automatically released, they are again set in the cutting position by operating the handle. These new taps are made in three sizes, covering a range of from 1 3/8 up to 6 inches.



Collapsing Tap Developed by the Geometric Tool Co.

## Plugs and Receptacles for Portable Electric Equipment

The Pyle-National Co., 1334-1358 N. Kostner Ave., Chicago, Ill., has brought out a line of heavy-duty circuit breaking plugs and receptacles designed specifically for use with portable tools, appliances, and heating units.

These plugs and receptacles are approved for 20-ampere, 250-volt direct current or 460-volt alternating current. They are of a fully enclosed type, designed to withstand severe service conditions, being provided with cadmium-plated heavy-gage drawn-steel housings. The plugs and receptacles of this new line are capable of making and breaking circuits at the high voltages mentioned.

Explosion-proof Motor with Two Enclosing Frames

## "Doublenclosed" Explosion-Proof Motor

Two enclosing frames with an unusually large fan mounted between them are features of an explosion-proof motor being introduced on the market by the U. S. Electrical Mfg. Co., Los Angeles, Calif. The inner frame completely encloses the electrical windings, stator, rotor, anti-friction bearings, and bearing chambers, sealing these important parts against deteriorating substances. The outer frame covers and protects the whole unit.

Dust, fumes, and foreign matter are air-blasted from the passages between the inner shell and the outer frame. The cooling air does not come into contact with the windings or rotating parts, as it passes between the two frames.

## Welco Hydraulic-Pressure Generator

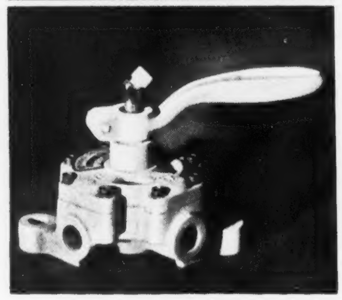
A hydraulic unit that will generate pressures up to 5000 pounds per square inch without overheating has been developed by the B. A. Wesche Electric Co., 1622-1628 Vine St., Cincinnati, Ohio. The illustration shows a typical application of this unit. It consists essentially of a radial pump having a normal working pressure of 1500 pounds per square inch, which is driven by a constant-speed electric motor. The unit functions by applying a column of oil under pressure to a work piston for moving a plunger. To reverse the movement of the piston, the direction of the oil movement is changed by reversing the driving motor or by changing the position of the pendulum carrying the unit.

This hydraulic-pressure generator is of the variable-delivery type, the oil volume being controlled at *A*. The control can be operated by screw pressure or by a cam or plunger, depending upon the requirements of the machine to which the unit is applied. The pump rotor has five pressure-generating pistons, there being only seven moving parts in the entire unit. This unit is self-contained, no separate oil reservoir being required.


Self-contained Hydraulic Unit Developing Pressures to 5000 Pounds per Square Inch

## Hanna "Unitite" Valves

Valves that can be completely dismantled from a pipe line without disturbing the piping have been developed by the Hanna Engineering Works, 1765 Elston Ave., Chicago, Ill. These valves can be used with air, oil, or water at pressures up to 250 pounds per square inch.



Unitite Valve Suitable for Air, Oil, or Water Lines

The valve disk seats on the bonnet, and both the disk and bonnet can be reground when necessary without removing the valve body from the pipe line or disturbing the pipe connections or valve mountings. Parts can be replaced by merely removing several socket-head cap-screws.

Permanent tightness is one of the advantages claimed for this design. The valves can be used as straight-way, three-way, or four-way valves. They are made in five sizes, from 3/8 to 1 1/4 inches, inclusive.

* * *

## Trade—Buying as Well as Selling

The fundamental function of business is trade—and trade consists of buying as well as selling. It is not enough that industry make strong effort to sell. Individuals and industries with money or credit must also make a relative effort to buy. Those who buy what they really need within their reasonable means will have a stronger heart to sell. Salesmen and others on whom responsibility for selling rests will have more courage to push the hesitant buyer when they are backed by the knowledge that their own organization is doing its part on the other side of bringing back trade. With commodity prices moving upward, such purchases will prove to be profitable purchases.—*Herman H. Lind, General Manager, National Machine Tool Builders' Association*

# NEWS OF THE INDUSTRY

## Delaware and Maryland

John Beard, formerly with Sharples Specialty Co. of Philadelphia, Pa., is now associated with the Haveg Corporation, Newark, Del., manufacturer of corrosion-resistant chemical equipment. The Haveg Corporation is an associate of the Continental-Diamond Fibre Co.

Pangborn Corporation, Hagerstown, Md., has just completed an addition to its plant. The company, which already has the world's largest plant for the manufacturing of blast-cleaning and dust-collecting equipment, firmly believes in the increasing demand for such equipment with the revival in business, and has deemed it advisable to build this addition, which will cost over $100,000.

## Illinois

Neil C. Hurley has been elected president of the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. He succeeds Ralph S. Cooper, who was named vice-president in charge of eastern operations of the firm, with headquarters in New York. Frank B. Hamerly was elected vice-president in charge of the factory at Aurora, Ill., and Gordon H. McCrae, 40 Broadway, London, England, vice-president in charge of foreign business. F. W. Buchanan was made secretary, and Edward G. Gustafson, treasurer.

P. E. Floyd has been appointed district sales manager in charge of the Chicago territory of the Ludlum Steel Co., Watervliet, N. Y. Mr. Floyd will supervise the sales of all Ludlum lines, including tool steels, Nevastain, stainless steel, Nitralloy, and Carmet carbide metal. Previous to his recent appointment, he was connected in a similar capacity with the Associated Alloy Steel Co., and prior to that was Chicago manager of the Ludlum Steel Co.

American Machinery and Tools Institute, 40 N. Wells St., Chicago, Ill., announces that Fred J. Schlegel of Pottstown, Pa., has been awarded a Certificate of Merit for having submitted the best paper on the subject "Economic Justification of the Small Machine or Tool Shop," in the recent contest arranged by the Institute.

Schucht-Mier-Robertson-Inc., 342 N. Water St., Milwaukee, Wis., consulting industrial engineers, announce, as a part of an expansion program, the appointment of Charles A. Charter as resident manager of the Chicago office, which was recently established at 201 N. Wells St.

## Michigan

American Society of Tool Engineers, Inc., 8316 Woodward Ave., Detroit, Mich., announces the election of the following officers for the coming year: President, William H. Smila, tool engineer, Chrysler Corporation; first vice-president, Frank Hartlep, chief tool engineer, Timkin-Detroit Axle Co.; second vice-president, T. B. Carpenter, assistant tool supervisor, General Motors Truck Corporation; secretary, A. M. Sargent, president and general manager, Pioneer Engineering & Mfg. Co ; treasurer, Joseph F. Slavik, sales engineer, Warner & Swasey Co.

Sterling-French Machinery Co., New Center Bldg., Detroit, Mich., has been appointed representative of the Sundstrand Machine Tool Co. of Rockford, Ill., in the Detroit territory and the Province of Ontario. D. B. Burleigh, formerly vice-president and sales manager of the Sundstrand Machine Tool Co., will handle the Sundstrand line for the Sterling-French Machinery Co.

Seneca Falls Machine Co., Seneca Falls, N. Y., has appointed the Cadillac Machinery Co., Fisher Bldg., Detroit, Mich., exclusive representative in the Detroit district for the sale of Lo-Swing and Short-Cut lathes and automatic loading devices. W. H. Nettle, formerly western sales manager for the Seneca Falls Machine Co., is now connected with the Cadillac Machinery Co.

Schols Tool & Machine Co., 321 Lake Michigan Drive, Grand Rapids, Mich., has acquired from the estate of W. D. Rearwin, all rights to the Rearwin sawing and filing machine, including patents, patterns, and good will, and will continue the manufacture of this machine. Additional tool equipment will be developed to augment this line.

F. W. Magin, formerly executive vice-president of the Square D Co., Detroit, Mich., was elected president at the last annual meeting of the board of directors; T. J. Kauffman was elected chairman of the board; H. S. Morgan, secretary-treasurer; and J. H. Pengilly, L. W. Mercer, Vernon Brown, and Carlton M. Higbie, vice-presidents.

Chain Belt Co., Milwaukee, Wis., has appointed the Keller Tractor & Equipment Co., Inc., of Detroit, Mich., distributor for the "Rex" line of construction equipment.

## New England

C. Newman Wire Co., Inc., and its manufacturing affiliate, J. D. Crosby Co., have consolidated their interests and will conduct their selling and manufacturing activities in the future under the name Newman-Crosby Steel Corporation, with executive offices and works at Pawtucket, R. I., and general sales office at 25 Church St., New York City. The personnel of the new organization will include the entire personnel and officials of the two companies. C. Newman is president of the new corporation.

Synthetic Moulded Products, Inc., announces the opening of a new plant at Stonington, Conn., on the Boston Post Road. The initial building is a modern brick structure, housing both office and manufacturing departments. The machine equipment is new throughout and of the latest cost-reducing type. The company manufactures all kinds of molded plastic parts.

Bullard Co., Bridgeport, Conn., announces the election of the following officers at the last meeting of the board of directors: E. P. Bullard, president; E. C. Bullard, D. B. Bullard, and J. W. Bray, vice-presidents; A. E. North, secretary-treasurer; and G. L. Todd, assistant secretary-treasurer.

## New York

Roy C. Muir, for three years assistant to the late Charles E. Eveleth, vice-president in charge of engineering of the General Electric Co., Schenectady, N. Y., has been appointed manager of the engineering department of the company. Mr. Muir will have direct charge of the company's designing engineering in all its various plants, the works laboratories, and the general engineering laboratory at Schenectady. He has been connected with the company for the last twenty-eight years.

Glenn L. Gardiner, assistant to the president of the Forstmann Woolen Mfg. Co., Passaic, N. J., has been elected a member of the board of directors of the Elliott Service Co., 250 W. 55th St., New York City. Mr. Gardiner is the author of several books on foreman training and personnel management, and a director of the Columbia University foremanship training extension course.

Shepard Niles Crane & Hoist Corporation, 444 Schuyler Ave., Montour Falls, N. Y., announces that the New York office of the company will be lo-

cated at 111 Broadway, New York City, effective May 1. The Philadelphia office is now located at the Niles Plant, Mifflin St., east of Front St., Philadelphia, Pa.

PETER J. MULVEY, who first began testing electric machinery at the Schenectady Works of the General Electric Co. forty-two years ago, retired March 31. For many years, Mr. Mulvey had charge of the testing of railway motors; then small motors and generators; and since 1931, induction motors.

HARNISCHFEGER CORPORATION, Milwaukee, Wis., announces the appointment of the Florandin Equipment Co., 40 W. 40th St., New York City, as welder representative of the company in the metropolitan district of New York and northern New Jersey.

## Ohio

LUDLOW VALVE MFG. CO., Troy, N. Y., has appointed the J. W. Frazier Co., 626 Western Reserve Bldg., Cleveland, Ohio, representative of the company in northern Ohio.

FRED B. JACOBS has become associated with the Cleveland Container Co., Abrasive Division, Cleveland, Ohio, manufacturer of abrasive sleeves and expanding polishing wheels, in the capacity of general sales and advertising manager. Mr. Jacobs has been connected with the abrasive industry for the last twenty-five years. He joined the sales force of the Carborundum Co., Niagara Falls, N. Y., in 1908, and was connected with that company for several years. Later he represented the Abrasive Co., Philadelphia, Pa., in the Middle West. In 1917, he entered the employ of the Penton Publishing Co., Cleveland, Ohio. He was made editor of *Abrasive Industry* when that paper was founded in 1920, and held that position until 1932. Mr. Jacobs is the author of several books on grinding.

© Bachrach

*Fred B. Jacobs, General Sales and Advertising Manager of Cleveland Container Co., Abrasive Division*

A majority stock interest and control of the SHEFFIELD MACHINE & TOOL CO., Dayton, Ohio, manufacturer of precision gages, has been acquired by interests identified with the CITY MACHINE & TOOL WORKS, of Dayton. C. H. REYNOLDS of Detroit, Mich., who has long been associated with the Cimatool and Sheffield organizations, becomes president of the Sheffield Machine & Tool Co. O. M. POOCK, president of the City Machine & Tool Works, will be treasurer, and LOUIS POOCK, general manager of the City Machine & Tool Works, will become vice-president and general manager.

*C. H. Reynolds, President of the Sheffield Machine & Tool Co.*

NATIONAL ACME CO., Cleveland, Ohio, announces that the Acme and Gridley automatic screw machines and chucking machines heretofore manufactured at the company's Windsor, Vt., plant will be made at the Cleveland plant in the future. The entire stock of spare and replacement parts and standard tooling equipment has been moved to Cleveland, and deliveries will now be made from this point. It is felt that the consolidation of the executive, manufacturing, and engineering departments in a central location like Cleveland will improve the service that the company is in a position to render. The executives and key men who supervised the manufacture of these machines in Windsor will continue their work at Cleveland.

RAY LINN, 1432 Jermain Drive, Toledo, Ohio, has become associated with the Ex-Cell-O Aircraft & Tool Corporation, 1200 Oakman Blvd., Detroit, Mich., and will represent that company in the Toledo territory. Mr. Linn will represent the Continental Tool Works and the Krueger-Wayne Tool Co., which are divisions of the Ex-Cell-O Aircraft & Tool Corporation, as well as all the products of the Ex-Cell-O organization.

## Pacific Coast

SMITH BOOTH USHER CO., Los Angeles, Calif., announces that its entire organization is now combined in one central location at 15th and Santa Fé Ave., Los Angeles. The general offices and stocks have been removed from 228 Central Ave. to the new location, consolidating them with the present store at 2001 Santa Fé Ave. The larger quarters now occupied will allow for the expansion of the various departments of the business.

HOMESTEAD VALVE MFG. CO., INC., Coraopolis, Pa., has appointed the C. Kirk Hillman Co., 3201 First St., Seattle, Wash., exclusive representative covering the state of Washington for the sale of "Hypressure Jenny," a vapor spray machine used for automotive, industrial, and building cleaning.

## Pennsylvania

TAYLOR & CO., INC., Norristown, Pa., have completed the construction of a new plant, where a complete line of vulcanized fiber, fish paper, and laminated phenolic products, including noiseless gears, will be manufactured. The new plant is equipped throughout with machinery of special design. L. T. McCloskey, formerly vice-president of the Continental-Diamond Fibre Co., is sales manager of Taylor & Co.

DELAWARE STEEL SERVICE, INC., Philadelphia, Pa., has been organized by G. F. Wilson, Gustaf Peterson, and S. B. Matthews, formerly of the Ludlum Steel Co., Philadelphia, Pa. The new company will represent several concerns, among others the Ludlum Steel Co. Complete lines of all the principal Ludlum products will be carried, including tool and special alloy steels, Nevastain, stainless steel, and Nitralloy.

PAUL F. HERMANN CO., 1910 Beechwood Blvd., Pittsburgh, Pa., representative of the O. K. Tool Co. and Thomas Prosser & Son, handling Widia tungsten-carbide tools, has now also taken over the exclusive representation of the Federal Products Corporation, Providence, R. I., for that company's line of precision dial indicators and gages.

F. C. CASTELLI CO., engineers and toolmakers, announce the removal of their plant and office from 136 N. 55th St., Philadelphia, Pa., to new and larger quarters at 4041 Ridge Ave., Falls of Schuylkill, Philadelphia, Pa.

# OBITUARIES

## Andrew C. Pearson

Andrew C. Pearson, chairman of the board of the United Publishers Corporation and president of the National Publishers' Association, died Friday, March 31, following a heart attack. Mr. Pearson was born in Coffeyville, Kan., in 1873, and graduated from Baker University, Baldwin, Kan., in 1895. Subsequently, he studied law at Northwestern University, Evanston, Ill., where he received the degree of LL.B. In 1898, he entered the publishing business, joining the advertising staff of the *Dry Goods Reporter*, which later became the *Dry Goods Economist*. He advanced rapidly in the publishing field until he became chairman of the board of the United Publishers Corporation, the publications of which include the *Iron Age*, the *Dry Goods Economist*, *Automotive Industries*, and other business journals.

Mr. Pearson took an active interest in the publishing industry. He became chairman of the postal committee of the National Publishers' Association in 1919, and president of the Association in 1928. At the time of his death, he was also a director of the Merchants Association of New York, and had previously served as a director of the Chamber of Commerce of the United States. In 1931, he was made a Chevalier of the Legion of Honor for services rendered the French Government during the World War.

Harold Whitmore Smith, until June, 1932, generating apparatus manager of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and widely known throughout the electrical industry, died in Pittsburgh, March 28, after a brief illness. Mr. Smith was born in Adelaide, South Australia, August 8, 1886, and graduated from the University of Adelaide with the degree of Bachelor of Science and diploma in Applied Science. Later he received the degree of Mechanical Engineering from Cornell University. After having completed an apprentice course with the Westinghouse organization, he was connected with the sales department for a time, later leaving that concern to engage in other activities. In 1912, he returned to Australia, and after five years there, came back to this country and again became connected with the Westinghouse company with whom he remained until his retirement a year ago.

Charles Edward Eveleth, vice-president of the General Electric Co., Schenectady, N. Y., died at Schenectady, March 25, at the age of fifty-seven, following an illness of several months. Mr. Eveleth had been connected with the company since his graduation from the Worcester Polytechnic Institute in 1899, and had been a vice-president since April, 1927.

# NEW BOOKS AND PUBLICATIONS

How to Figure Oxwelding and Cutting Costs. 8 pages, 8 1/2 by 11 inches. Published by the Linde Air Products Co., 30 E. 42nd St., New York City.

This publication should prove of value to managers and supervisors who wish to set up methods of figuring oxwelding and cutting costs best suited to their particular needs. Three different methods of computing material consumption, and the conditions under which each should be used, are presented in tabular form for ready reference. Examples are given to explain each method.

Pocket Tables for Cubics—A Systematic Method for Algebraic Treatment of Cubic Equations. By David Katz. 6 pages, 4 by 9 inches. Published by David Katz, South Milwaukee, Wis. Price, 35 cents.

This folder contains in a very condensed form methods and tables developed by the author for solving cubic equations without guesswork. The formulas and tables are arranged for quick reference.

White-Metal Bearing Alloys: Mechanical Properties at Different Temperatures and Service Tests. By Harry K. Herschman and John L. Basil. 5 pages, 6 by 9 inches. Published by the United States Department of Commerce, Washington, D. C., as Research Paper No. 512 of the Bureau of Standards. Price, 5 cents.

American Standard Spur-Gear Tooth Form. 10 pages, 8 by 10 1/2 inches. Published by the American Gear Manufacturers' Association, 201 First National Bank Bldg., Wilkinsburg, Pa., and the American Society of Mechanical Engineers, 29 W. 39th St., New York City. Price, 45 cents.

# COMING EVENTS

May 4-6—Annual meeting of the American Gear Manufacturers' Association at Wilkinsburg, Pa. J. C. McQuiston, manager-secretary, First National Bank Bldg., Wilkinsburg, Pa.

May 8-11—Annual meeting of American Supply and Machinery Manufacturers' Association at Louisville, Ky. R. Kennedy Hanson, secretary-manager, Clark Bldg., Pittsburgh, Pa.

May 10-12—Conference on Re-Engineering for Economical Manufacture, to be held at the Case School of Applied Science, Cleveland, Ohio. E. S. Ault, chairman, Case School of Applied Science.

May 24-25—Second National Lubrication Engineering Meeting to be held at Pennsylvania State College, State College, Pa. For program and further details, address Professor F. G. Hechler, Pennsylvania State College.

June 12-16 — Tenth National Oil Burner Show in Chicago, Ill. Harry F. Tapp, executive secretary, American Oil Burner Association, Inc., 342 Madison Ave., New York City.

June 19-23—Annual convention and exposition of the American Foundrymen's Association at the Hotel Stevens, Chicago, Ill. C. E. Hoyt, executive secretary-treasurer, 222 W. Adams St., Chicago, Ill.

June 25-30—Sixth Midwest Engineering and Power Exposition in the Coliseum, Chicago. Exposition headquarters, 308 W. Washington St., Chicago, Ill.

June 26-29—Semi-annual meeting of the American Society of Mechanical Engineers at the Hotel Stevens, Chicago, Ill., during "Engineering Week." Calvin W. Rice, secretary, 29 W. 39th St., New York City.

June 26-30—Annual meeting of the American Society for Testing Materials at the Hotel Stevens, Chicago, Ill. C. L. Warwick, secretary-treasurer, 1315 Spruce St., Philadelphia, Pa.

June 27-30—National Convention of the Society of Industrial Engineers at the Hotel Stevens, Chicago, Ill. George C. Dent, executive secretary, 205 W. Wacker Drive, Chicago, Ill.

August 28-September 4—International Automotive Engineering Congress to be held at the Palmer House, Chicago, Ill., under the auspices of the Society of Automotive Engineers. John A. C. Warner, general manager, 29 W. 39th St., New York City.

September 15-16—Annual convention of the National Association of Foremen at Akron, Ohio. Secretary, E. H. Tingley, Refiners Bldg., Dayton, Ohio.

# Classified Contents of this Number



Your Progress Depends Upon Your Knowledge of Your Industry